Detection and Evaluation of Elevated Lead Release from Service Lines: A Field Study

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Miguel A. Del Toral[1]*
Andrea Porter[1]
Michael R. Schock[2]

[1]U.S. Environmental Protection Agency, GWDWB, 77 West Jackson Blvd (WG-15J), Chicago, IL 60604
[2] U.S. Environmental Protection Agency, ORD, NRMRL, 26 W. Martin Luther King Dr., Cincinnati, Ohio 45268

*Corresponding author: email: deltoral.miguel@epa.gov

The supporting information provides additional background information, summaries and graphics for the underlying data used in the study.

Background

The Lead and Copper Rule (LCR) is a treatment technique regulation that requires all public water systems to optimize corrosion control and utilizes tap sampling for lead and copper to determine whether additional actions need to be taken by the system. It is important to note that the sampling conducted under the LCR is not designed to evaluate individual consumers' lead exposure or risk and that the lead action level (AL) was not established as a health-based number. The lead AL is the level which EPA determined in 1991 that systems could feasibly meet, taking into account the available treatment technologies and the cost of those treatment technologies. The lead AL should not be viewed or used as a threshold value to determine whether the water is safe or unsafe to drink, and it should be reiterated that the EPA and CDC have determined that there is no safe level of lead exposure (i.e., no level at which there is not an adverse effect).

Tap sampling conducted under the LCR is intended to measure the amount of lead and copper corrosion that is occurring in public water systems using worst-case site selection and a specified sampling protocol. The sampling protocols in the current LCR were established in 1991, based on the existence of many potential sources of lead throughout the water distribution system, including lead service lines connecting the water main to the homes, leaded-solder used to join copper pipe, and leaded-brass devices, such as meters, brass connectors and shut-off valves, faucets and fixtures. The current LCR sampling requirements are prescriptive and based on the relative significance of lead sources in 1991. The sequential sampling protocol (described below, and in the accompanying paper) that resulted in capturing the highest lead, as well as the sample results themselves, are not allowed to be used in the current compliance calculation.

The LCR utilizes a combination of: worst-case site selection (sites expected to yield the highest lead results); sampling protocols used to capture the highest lead; and repeated sampling at the same sites in order to measure the level of lead corrosion that is occurring throughout the water distribution system. Utilizing this sampling structure allows U.S. EPA to keep the sampling burden on public water systems manageable, while still accomplishing the objectives of the sampling under the LCR. Absent these key components, the number of samples needed to accurately assess system-wide corrosion would necessarily need to increase substantially to accomplish the objectives of the LCR.

The action level for lead is 0.015 mg/L, but is presented here as 15 μg/L for the purpose of using consistent units for the data. An exceedance of the lead AL based on the sampling triggers specific actions that a public water system must undertake to protect public health, such as installing or adjusting corrosion control treatment and providing public education. Additionally, where the corrosion control treatment has proven ineffective at lowering lead levels below the lead AL, the removal of lead service lines is triggered. There are many different corrosion mechanisms and factors that govern lead corrosion. The selection of sampling sites, sampling protocol, and site conditions are essential components for evaluating the level of corrosion that is occurring in the distribution system, regardless of the mechanism(s) or contributing factor(s). It is therefore critically important that the sampling protocol accurately portray the level of corrosion that is occurring.

Lead Service Line and Plumbing Information

As part of the sampling protocol, residents were asked to provide a plumbing profile (figure S1), describing their internal plumbing, and identifying the location of the kitchen tap, and shut-off valve/meter.

Volunteer ID: ______________

Home Plumbing and Service Line Diagrams

Below there are 4 diagrams for common household plumbing configurations and the 5th diagram is blank. Please review the diagrams and select the diagram that best matches the plumbing configuration for your home. Each of the diagrams shows where the water service line comes into the home and where the kitchen tap is located. If none of the four diagrams matches your home, use the blank diagram (number 5) to draw where the water service line comes into your home and where your kitchen tap is located. If you do not know where the service line comes into the home, you can note that in your Home Plumbing description below.

Note: Some homes have water meters and some do not. On the diagrams below, if you do not have a water meter, pick the diagram that matches where your service line comes into your home and where the kitchen tap is, and cross out the meter symbol

Home Plumbing Description: In the space below, please describe your home plumbing as best you can, from the point at which the water service line comes into your home to the location of your kitchen tap (length of pipe, diameter of pipe, pipe material, etc.):

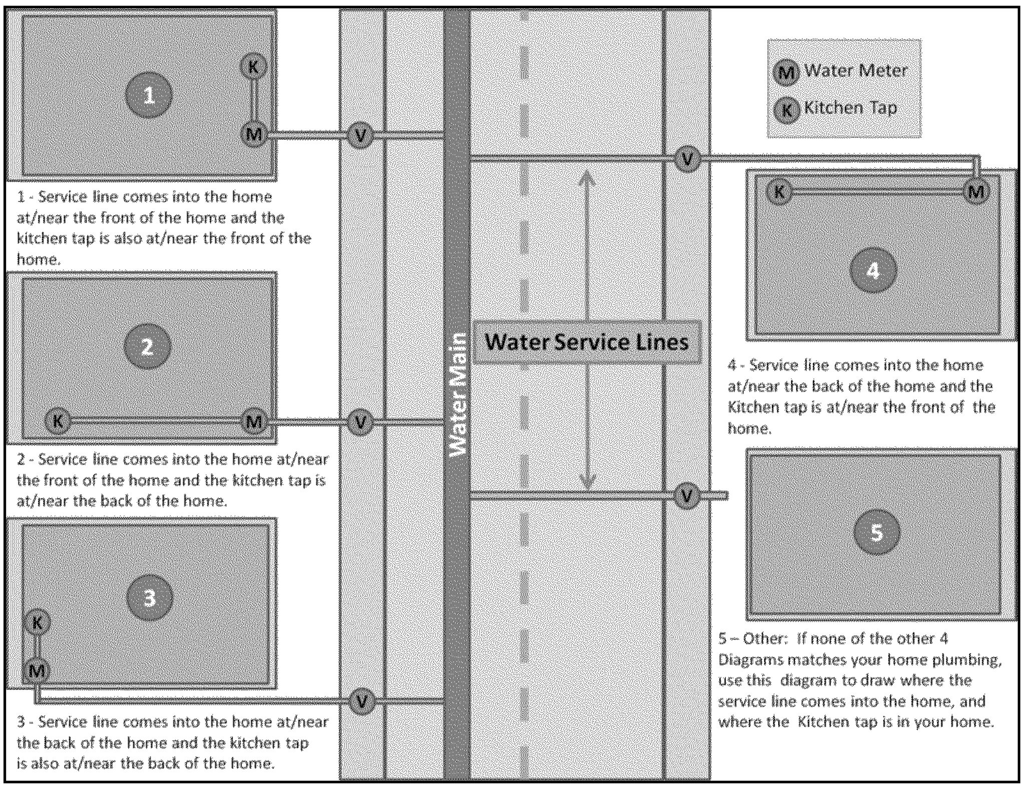


Figure S1: Plumbing Profile Diagram

Table S1 contains a summary of the LSL information for each sampling site. Due to the site-specific plumbing characteristics, the liter which first begins to capture LSL water at each site was expected to be variable, as was the liter which would begin to collect uncontaminated water from the water mains. The study findings regarding whether the current sampling protocol is capturing the corrosion that is occurring are not affected by this limitation.

Site	LSL Length ft (meters)	LSL End Point	Site	LSL Length ft (meters)	LSL End Point
1	89 (27.1)	BFW	22	65 (19.8)	IFW
3	73 (22.3)	IFW	23	66 (20.1)	IFW
4	Unknown	Unknown	24	56 (17.1)	IFW
5	80 (24.4)	IBW	25	70 (21.3)	IFW
6	60 (18.3)	IFW	26	66 (20.1)	IFW
7	59+ (18.0+)	BFW	27	47+ (14.3+)	Unknown
8	57 (17.4)	IFW	28	61+ (18.6+)	Unknown
9	102 (31.1)	BFW	29	159 (48.5)	BFW
10	48+ (14.6+)	IFW	30	49+ (14.9+)	Unknown
11	50 (15.2)	IFW	31	71+ (21.6+)	IFW
12	53 (16.2)	IFW	32	43 (13.1)	IFW
13	49+ (14.9+)	Unknown	33	43+ (13.1+)	IFW
17	58+ (17.7+)	Unknown	34	Unknown	Unknown
18	76 (23.2)	IFW	35	80 (24.4)	BFW
19	63(19.2)	IFW	36	110 (33.5)	IBW
21	46 (14.0)	IFW	38	51 (15.5)	IFW

IFW = LSL ends just inside the front wall
IBW = LSL ends just inside the back wall
BFW = LSL ends at an unknown distance beyond the front wall
+ = Indicates that the LSL was measured from the water main to the front the home, and it is not known whether the LSL extends beyond the front wall of the home.

Table S1: LSL Lengths – The length of the LSLs for most sites were measured and are presented in this table. The LSLs for two sites (site 4 and site 34) were not measured.

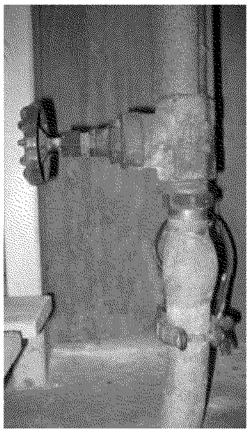


Figure S2: LSL Bulb

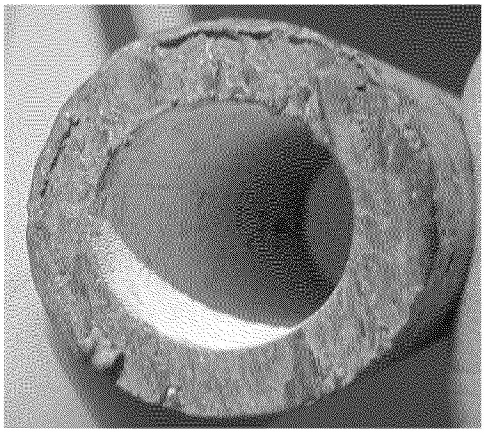


Figure S3: LSL segment (3/4 inch / 1.91 cm diameter)

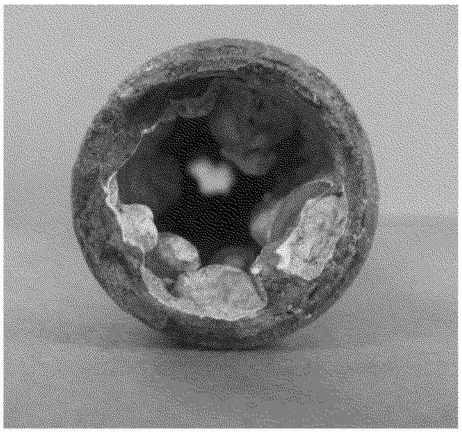


Figure S4: Severely corroded galvanized iron pipe.

Figure S2 shows a typical LSL in Chicago coming up from the foundation of the basement. The lead service line is a dull gray and easily scratched with a key. The soft LSL is typically soldered to the interior (household) plumbing, leaving a characteristic bulb. The LSL can also be connected to household pipe using a brass compression fitting.

Figure S3 is a close-up of a 3/4 inch (1.91 cm) diameter LSL, showing the thickness of a typical LSL.

Figure S4 is a cross-section of a severely corroded galvanized pipe from one of the sample sites. In this photograph the inner diameter is significantly reduced which affects the volume of water that will flow through the pipe in a set amount of time. For homes with corroded galvanized pipe, water will flow slower through the pipe and longer flushing times are generally needed to flush the lead from the plumbing.

City Information

Samples were collected from 32 single-family homes in Chicago with LSLs. Twenty-three homes were in the Jardine Plant service area and nine homes were in the South Plant service area.

Site #	Home Built	Service Area
01	1893	Jardine
03	1960	Jardine
04	1941	South
05	1901	South
06	1953	Jardine
07	1900	Jardine
08	1941	Jardine
09	1920	Jardine
10	1943	Jardine
11	1912	Jardine
12	1952	Jardine
13	1950	South
17	1907	Jardine
18	1953	Jardine
19	1912	Jardine
21	1938	Jardine
22	1924	Jardine
23	1944	South
24	1906	Jardine
25	1917	South
26	1954	South
27	1891	Jardine
28	1932	Jardine
29	1890	Jardine
30	1954	South
31	1923	Jardine
32	1923	South
33	1927	Jardine
34	1915	Jardine
35	1900	Jardine
36	1957	South
38	1927	Jardine

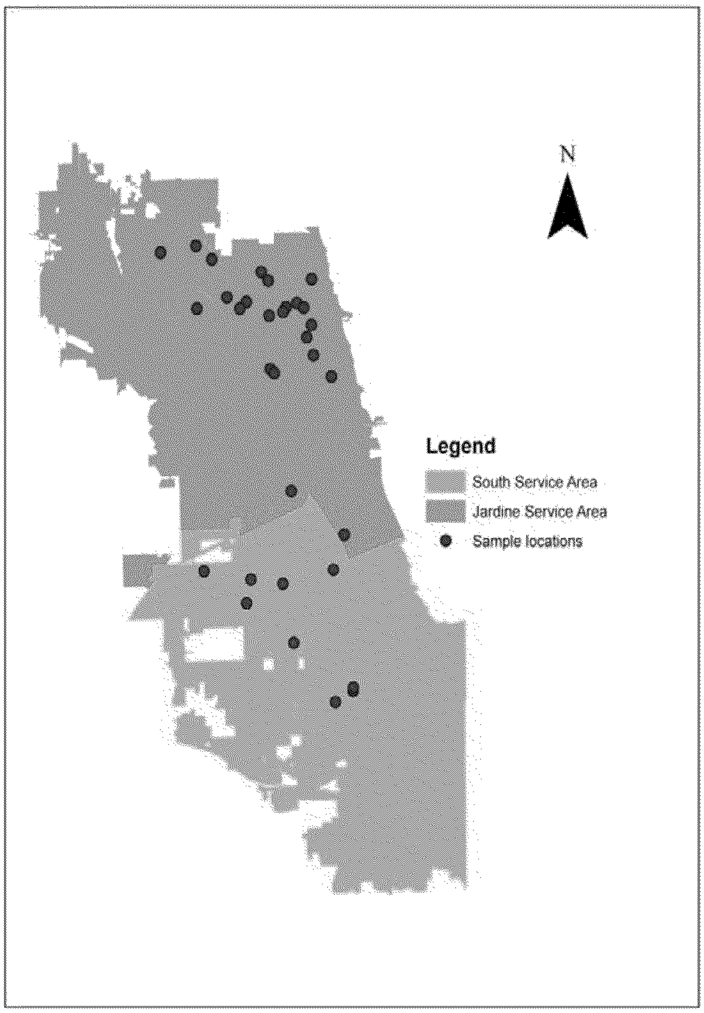


Figure S5: Home age and plant service areas for sampling locations

Table S2 contains a summary of the City's compliance monitoring data for lead. The City exceeded the lead AL only once, during the July-December 1992 compliance monitoring period.

City of Chicago (1992 – 2010) 90th Percentile Lead Values (µg/L)			
Monitoring Period Begin	**Monitoring Period End**	**Number of Samples**	**90th Percentile Value**
1/1/2008	12/31/2010	50	6
1/1/2005	12/31/2007	50	6
1/1/2002	12/31/2004	50	4
1/1/1999	12/31/2001	50	7
1/1/1999	12/31/1999	50	8
1/1/1998	12/31/1998	53	14
7/1/1997	12/31/1997	100	11
1/1/1997	6/30/1997	100	10
1/1/1993	6/30/1993	100	13
7/1/1992	12/31/1992	120	**20**
1/1/1992	6/30/1992	100	10

Table S2: City of Chicago 90th Percentile Compliance Values (1992 – 2010)

Laboratory and Analytical Information

All samples were inspected for visible particulates prior to delivery to the laboratory. In light of the significant increase in visible particulate in the final round of monitoring, the presence of fine particulates that would readily dissolve in the nitric acid preservative should not be discounted. Samples collected during the final round of monitoring coincided with the Fire Department's annual valve exercising. Colloidal lead may explain some of the variability in lead levels between the June and Sept/Oct rounds.

Laboratory blanks, laboratory fortified blanks and laboratory fortified samples were run at a frequency of at least one per twenty samples. Laboratory blanks run with the samples did not have any detections of lead above the reporting limit and all Laboratory fortified blanks and laboratory fortified samples had recoveries greater than 90%.

All laboratory instrumentation was inspected and maintained according to Chicago Regional Laboratory maintenance protocols, and calibrated daily according to Chicago Regional Laboratory standard operating procedures.

The Chicago Regional Lab Quality Assurance (QA) Contact performed a data quality assessment on the results based on laboratory blanks, laboratory fortified blanks and matrix spikes. The QA Contact identified no biases in the sample results due to these quality control measurements.

Sampling Summaries

Sample site summary table - A summary table of the types of samples collected at each site, for each sampling protocol is presented in Table S3 below. The highlighted rows for Sites 2, 14, 15, 16 & 37 were confirmed not to have LSLs and Site 20 is the same residence as Site 21 (Kitchen tap and bathroom tap). Following the first round of sampling, Site 20 (bathroom tap) was no longer sampled, to maintain consistency of using kitchen taps across all sites. Only sample results from LSL sites are presented and analyzed in the study paper. The first liter of the sequential samples in June and Sept/Oct also serve as the PF first-draw samples.

Summary of Samples Collected at Each Site							
Site #	Total # Samples	Mar/April		June	Sept/Oct		
		Day 1	Day 2	Day 1	Day 1	Day 2	Day 3
01	34	A, C	B, D	E-12 samples	A	E-14 samples	F, G, H
02	16	A, C	B, D	E-12 samples	DNS	DNS	DNS
03	30	A, C	B, D	E-12 samples	A	E-11 samples	F, G
04	16	A, C	B, D	E-11 samples	DNS	DNS	DNS
05	28	A, C	B, D	E-12 samples	A	E-11 samples	DNS
06	28	A, C	B, D	E-12 samples	A	E-11 samples	DNS
07	35	A, C	B, D	E-12 samples	A	E-15 samples	F, G, H
08	35	A, C	B, D	E-12 samples	A	E-15 samples	F, G, H
09	30	A, C	B, D	E-12 samples	A	E-11 samples	F, G
10	34	A, C	B, D	E-12 samples	A	E-14 samples	F, G, H
11	30	A, C	B, D	E-12 samples	A	E-11 samples	F, G
12	34	A, C	B, D	E-12 samples	A	E-14 samples	F, G, H
13	16	A, C	B, D	DNS	A	E-11 samples	DNS
14	4	A, C	B, D	DNS	DNS	DNS	DNS
15	4	A, C	B, D	DNS	DNS	DNS	DNS
16	4	A, C	B, D	DNS	DNS	DNS	DNS
17	34	A, C	B, D	E-12 samples	A	E-14 samples	F, G, H
18	30	A, C	B, D	E-12 samples	A	E-11 samples	F, G
19	27	A, C	B, D	E-12 samples	DNS	E-11 samples	DNS
20	4	A, C	B, D	DNS	DNS	DNS	DNS
21	28	A, C	B, D	E-12 samples	A	E-11 samples	DNS
22	28	A, C	B, D	E-12 samples	A	E-11 samples	DNS
23	30	A, C	B, D	E-12 samples	A	E-11 samples	F, G
24	33	A, C	B, D	E-12 samples	A	E-14 samples	F, G
25	16	A, C	B, D	E-12 samples	DNS	DNS	DNS
26	30	A, C	B, D	E-12 samples	A	E-11 samples	F, G
27	33	A, C	B, D	E-12 samples	A	E-14 samples	F, G
28	30	A, C	B, D	DNS	A	E-11 samples	F, G
29	40	A, C	B, D	E-12 samples	A	E-20 samples	F, G, I
30	18	A, C	B, D	DNS	A	E-11 samples	F, G
31	31	A, C	B, D	E-12 samples	A	E-12 samples	F, G
32	28	A, C	B, D	E-12 samples	A	E-11 samples	DNS
33	33	A, C	B, D	E-12 samples	A	E-14 samples	F, G
34	18	A, C	B, D	DNS	A	E-11 samples	F, G
35	30	A, C	B, D	E-12 samples	A	E-11 samples	F, G
36	30	A, C	B, D	E-12 samples	A	E-11 samples	F, G
37	4	A, C	B, D	DNS	DNS	DNS	DNS
38	16	A, C	B, D	E-12 samples	DNS	DNS	DNS

A = NHU First-draw Sample
B = PF First-draw Sample
C = NHU 45-Second Flushed Sample
D = PF 45-Second Flushed Sample
E = Sequential Sample
F = 3-minute Flushed Sample
G = 5-minute Flushed Sample
H = 7-minute Flushed Sample
I = 10-minute Flushed Sample
DNS = Site did not sample

Table S3: Summary of samples collected at each site using each sampling protocol.

First-draw and 45-second flushed samples – Results for first-draw and 45-second flushed samples using the normal household use (NHU) and pre-flushed (PF) sampling protocols are presented in Table S4 below.

In addition to the first-draw samples, a 45-second flush sample was collected by running the water for 45 seconds immediately following the collection of the NHU first-draw and PF first-draw samples during the March/April sampling. Overall, the 45-second flush sample results were higher than the first-draw results, and yielded a higher percentage of results above the lead AL. A total of 32 NHU/45-second flushed and 32 PF/45-second flushed samples were collected, with 6 NHU 45-second flushed results above the lead AL (19%), and 5 PF/45-second flushed results above the AL (16%). The total number of 45-second flush sample results above the lead AL was 11 of 64 (17%); a percentage significantly higher than the first-draw results (2%).

First-draw and 45-second Flushed Sample Lead Results (µg/L)							
Site	A (Mar/Apr)	C (Mar/Apr)	B (Mar/Apr)	D (Mar/Apr)	B (June)	A (Sept/Oct)	B (Sept/Oct)
1	5.93	11.3	5.94	11.9	6.98	7.37	9.19
3	5.60	12.0	6.01	6.71	5.82	10.0	8.28
4	3.25	6.76	3.12	2.56	3.61	DNS	DNS
5	3.84	13.2	4.97	14.1	2.56	3.04	2.76
6	2.31	1.90	2.07	2.13	2.50	2.44	2.25
7	4.74	15.3	4.62	**24.9**	4.91	5.12	4.03
8	11.2	**32.2**	7.12	**28.0**	11.1	**17.5**	9.24
9	6.82	**15.9**	9.80	**17.7**	10.4	15.3	8.29
10	5.46	**25.0**	3.06	**21.6**	3.70	4.98	3.46
11	8.08	4.13	3.85	5.30	2.15	3.53	2.96
12	1.99	**17.2**	9.36	5.45	1.80	2.27	5.35
13	2.68	3.50	3.05	2.94	DNS	2.53	1.88
17	2.83	4.00	2.50	3.70	2.37	2.65	2.73
18	5.98	9.57	6.60	12.4	4.55	5.80	4.75
19	2.59	4.69	1.92	8.27	2.90	DNS	3.01
21	2.81	6.87	2.60	13.8	3.16	4.13	2.99
22	3.91	9.19	3.36	7.93	2.06	3.21	2.29
23	5.97	13.1	5.80	11.5	8.30	9.16	7.02
24	3.33	6.10	3.05	4.98	4.63	7.57	6.62
25	3.41	3.75	ND	ND	4.28	DNS	DNS
26	3.89	3.02	3.12	3.45	3.51	4.53	4.88
27	5.19	4.53	5.36	3.76	8.06	8.30	12.6
28	2.51	4.99	2.47	4.70	DNS	4.26	3.94
29	12.8	13.5	12.1	**28.6**	13.7	1.9	17.6
30	7.56	12.5	4.72	6.52	DNS	8.39	7.88
31	2.53	3.16	2.92	12.3	4.03	4.67	5.97
32	6.18	2.29	2.90	7.82	3.08	3.36	2.94
33	4.25	**16.4**	3.51	14.0	5.18	5.55	5.52
34	4.12	1.51	1.88	3.30	DNS	2.07	1.52
35	3.53	5.28	2.04	10.5	2.86	5.02	3.44
36	5.11	11.1	4.56	8.76	5.02	5.88	4.61
38	1.87	1.60	1.66	2.30	1.92	DNS	DNS
Ave	4.76	9.23	4.25	9.74	4.82	5.73	5.45
n	32	32	32	32	28	28	29
A = NHU First-draw Sample B = PF First-draw Sample C = NHU 45-Second Flushed Sample				D = PF 45-Second Flushed Sample DNS = Site did not sample n = number of samples collected			

Table S4a: First-Draw and 45-Second Flushed Sampling Results. Samples that were above the lead AL are in bold, and samples that contained visible particulates are shaded yellow.

Summary of NHU and PF First-Draw Results					
	NHU (Mar/Apr)	PF (Mar/Apr)	PF (June)	NHU (Sept/Oct)	PF (Sept/Oct)
90th %ile Pb Value (µg/L)	8	7	8	10	9
No. of Samples	32	32	28	29	30
No. > AL	0	0	0	2	1

Table S4b: Comparison of LCR-equivalent 90th percentile results using alternative first-draw protocols.

Sequential sampling results (June 2011) – The sequential sampling approach provided a more reliable (volumetric) method for assessing corrosion as compared to a flushed (time-based) approach. Attempting to characterize the flow at each site would require an evaluation of the plumbing materials and dimensions, as well as the condition of the plumbing materials at each site, is not a feasible or reliable protocol for compliance monitoring.

The results of the each liter in the sequential sampling conducted in June are tabulated below in Table S5 by site.

June Sequential Sampling Results by Site/Liter (µg/L)												
	Liter											
Site	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
01	6.98	10.5	**24.8**	**27.8**	**27.5**	**24.3**	**22.6**	**17.8**	**19.5**	**20.0**	**21.1**	**19.6**
03	5.82	8.91	9.18	10.2	13.1	14.6	14.4	12.9	12.1	11.6	10.7	9.34
04	3.61	5.56		7.17	8.90	9.41	8.78	8.30	5.14	3.59	3.11	2.96
05	2.56	6.73	14.0	**17.3**	**16.5**	9.85	6.72	6.29	6.01	5.73	5.65	5.60
06	2.50	2.23	2.28	2.57	2.44	2.75	2.65	2.59	3.57	5.26	4.67	4.80
07	4.91	5.45	6.28	6.73	7.03	**22.9**	**23.6**	**19.7**	**16.3**	**16.2**	**16.7**	14.6
08	11.1	12.8	**21.6**	**19.7**	**32.0**	**33.5**	**32.2**	**28.9**	**32.1**	**29.7**	**24.2**	**18.7**
09	10.4	**18.0**	**20.8**	**20.0**	**17.9**	**17.0**	**15.8**	14.7	14.3	12.9	11.5	9.48
10	3.70	5.20	5.39	6.49	14.9	**23.6**	**22.4**	**21.9**	**23.9**	**20.2**	**20.7**	**20.9**
11	2.15	2.58	2.76	2.97	3.36	3.61	3.73	3.82	4.28	4.11	4.11	4.43
12	1.80	2.95	3.55	6.69	**20.9**	**26.9**	**25.7**	**25.1**	**24.9**	**22.4**	**15.9**	7.80
17	2.37	8.46	7.12	7.20	7.27	10.5	9.91	9.56	**22.6**	**23.3**	**24.7**	6.30
18	4.55	5.73	5.12	6.43	5.41	5.62	5.5	9.38	14.0	12.1	11.3	11.6
19	2.90	2.62	2.41	8.22	4.58	3.16	4.02	5.07	4.57	4.06	3.31	2.82
21	3.16	3.12	3.08	2.97	13.0	**20.6**	**18.7**	**16.4**	**16.3**	14.2	6.78	3.21
22	2.06	2.82	5.11	5.42	6.89	12.6	7.80	7.11	6.52	6.55	7.55	7.45
23	8.30	9.06	11.1	13.5	13.2	12.4	11.7	11.0	9.55	7.16	5.69	5.41
24	4.63	6.06	6.43	5.24	5.06	4.91	5.02	8.21	11.9	12.6	11.9	12.2
25	4.28	4.28	4.15	4.23	6.82	10.9	11.3	10.9	10.1	9.68	9.17	8.82
26	3.51	3.83	3.99	3.93	3.86	3.99	4.00	4.01	4.12	4.39	4.30	4.23
27	8.06	9.13	9.84	10.3	10.4	11.4	13.10	13.9	14.2	13.3	12.2	10.1
29	13.7	**35.7**	**18.8**	**17.7**	**16.8**	**16.5**	**16.6**	**15.7**	14.4	14.1	13.7	13.4
31	4.03	5.03	5.14	6.17	13.1	**15.4**	**15.6**	**16.3**	**20.8**	**18.8**	7.91	4.48

June Sequential Sampling Results by Site/Liter (µg/L)												
	Liter											
Site	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
32	3.08	2.29	2.07	2.28	6.95	15.5	9.91	9.27	8.30	6.12	2.60	1.65
33	5.18	6.85	10.0	7.74	9.61	13.9	**16.4**	13.5	12.3	13.7	10.7	9.95
35	2.86	7.89	12.9	11.9	9.85	8.59	7.28	6.82	6.23	5.34	5.02	4.83
36	5.02	6.90	7.68	8.46	9.90	9.81	9.51	9.34	9.19	8.93	9.20	9.19
38	1.92	3.04	3.06	3.04	2.91	3.03	3.12	3.07	3.36	3.21	3.04	3.76
Min	*1.80*	*2.23*	*2.07*	*2.28*	*2.44*	*2.75*	*2.65*	*2.59*	*3.36*	*3.11*	*2.60*	*1.65*
Max	*13.7*	***35.7***	***24.8***	***27.8***	***32.0***	***33.5***	***32.2***	***28.9***	***32.1***	***29.7***	***24.7***	***20.9***
Ave	*4.83*	*7.28*	*8.42*	*9.07*	*11.1*	*13.1*	*12.4*	*11.7*	*12.5*	*11.7*	*10.3*	*8.50*
90th %ile	*10.4*	*12.8*	***20.8***	***19.7***	***20.9***	***24.3***	***23.6***	***21.9***	***23.9***	***22.4***	***21.1***	***18.7***

Table S5: Summary of June Sequential Sampling Results. Samples that were above the lead AL are in bold, and samples that contained visible particulates are shaded yellow.

Sequential Sampling Results (September and October 2011) – The results of the each liter in the sequential sampling conducted in September and October are tabulated below in Table S6 by site. Considerably more sample results contained visible particulates than in previous rounds. The presence of particulates may be a result of the Chicago Fire Department exercising valves during the time period when samples were being collected.

All sites collected at least 11 sequential samples, and some sites with high sample results in June collected additional samples. The additional sequential sample results are included here but were not included in the data analyses, since extra samples were collected only from sites with high lead. A review of the data, including and excluding these additional results was performed to ensure that a bias has not been introduced, and the review indicates that the study findings are not significantly affected by including or excluding the data. With the additional 39 samples included, a total of 80 of 358 sample results (22%) exceeded the lead AL. Using only samples 1 through 11 from each site, a total of 75 of 319 sample results (24%) exceeded the lead AL. For the purpose of the data analyses, the first liter sample from the sequential samples in June and Sept/Oct also serve as the first-draw PF sample.

Sept/Oct Sequential Sampling Results by Site/Liter (µg/L)											
	Liter										
Site	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
01	9.19	12.8	**21.4**	**22.3**	**22.0**	**19.6**	**16.5**	**15.6**	14.5	14.2	13.8
03	8.28	5.58	5.17	6.43	8.46	14.9	**19.6**	**16.4**	**15.4**	14.3	**17.1**
05	2.76	10.8	12.2	10.9	12.3	7.21	5.49	5.24	4.65	5.30	5.40
06	2.25	2.18	3.43	2.37	2.30	2.28	2.81	2.32	2.20	4.16	5.03
07	4.03	4.27	5.74	5.75	9.87	15.1	15.3	15.2	12.1	14.8	13.9
08	9.24	8.95	9.45	11.8	**18.3**	**25.0**	**22.7**	**22.3**	**22.9**	**19.1**	**15.8**
09	8.29	**20.0**	**18.8**	**21.3**	**20.0**	**17.6**	**16.3**	**15.7**	14.6	14.8	**16.1**
10	3.46	6.27	6.23	5.05	14.8	**21.4**	**33.1**	**29.8**	**32.4**	**28.1**	**27.7**
11	2.96	4.05	3.90	3.91	4.30	4.44	4.35	4.71	5.02	4.75	4.47
12	5.35	**15.7**	**16.4**	**19.8**	**23.0**	**30.3**	**25.7**	**22.4**	**19.0**	**17.3**	12.2
13	1.88	7.73	9.01	3.57	2.53	3.85	2.96	2.17	2.85	7.55	5.74
17	2.73	2.38	5.45	4.41	4.07	4.09	3.72	3.42	3.35	3.42	3.17
18	4.75	5.09	4.91	5.53	4.81	8.17	8.61	8.67	11.6	11.6	11.4
19	3.01	3.07	2.75	3.80	3.25	3.37	5.80	6.01	6.15	5.18	3.83
21	2.99	3.35	3.03	3.04	**16.8**	**18.2**	**16.1**	13.2	14.9	15.0	5.24
22	2.29	2.86	5.60	5.39	6.32	8.49	7.42	7.20	6.64	7.09	7.36
23	7.02	8.00	8.99	11.0	12.5	12.1	12.8	11.8	10.5	12.1	10.1
24	6.62	8.84	7.30	6.38	6.45	6.59	6.82	10.6	14.5	13.2	12.8
26	4.88	4.61	4.52	4.46	4.52	4.26	5.18	5.40	5.94	5.72	5.82
27	12.6	12.4	12.2	12.5	12.5	13.1	**16.3**	**18.0**	**18.9**	**19.6**	**17.3**
28	3.94	5.58	5.39	5.32	5.39	5.11	5.73	5.65	5.30	5.49	5.55
29	**17.6**	**36.7**	**18.3**	**17.3**	**16.6**	**15.9**	**15.9**	14.3	**16.2**	12.8	13.2
30	7.88	7.46	8.67	9.54	9.09	11.0	12.9	**22.9**	**31.3**	**31.8**	**33.1**
31	5.97	5.82	5.20	6.72	15.6	13.4	**17.3**	**18.5**	**23.9**	**16.3**	5.70
32	2.94	2.24	2.03	2.22	5.50	**17.3**	9.42	9.07	8.63	7.64	3.50
33	5.52	6.26	12.8	9.09	12.0	14.1	**21.6**	**16.6**	**16.5**	**15.8**	14.1
34	1.52	1.72	1.69	1.62	1.73	2.66	2.91	2.87	3.17	2.10	1.90
35	3.44	7.42	14.6	**18.9**	**16.0**	12.5	10.1	9.56	7.60	8.18	7.21
36	4.61	5.01	5.51	6.11	13.0	11.6	10.3	10.4	10.9	10.3	9.93
Min	*1.52*	*1.72*	*1.69*	*1.62*	*1.73*	*2.28*	*2.81*	*2.17*	*2.20*	*2.10*	*1.90*
Max	***17.6***	***36.7***	***21.4***	***22.3***	***23.0***	***30.3***	***33.1***	***29.8***	***32.4***	***31.8***	***33.1***
Ave	*5.45*	*7.83*	*8.30*	*8.50*	*10.5*	*11.9*	*12.2*	*12.0*	*12.5*	*12.0*	*10.6*
90th %ile	*9.19*	*12.8*	***16.4***	***18.9***	***18.3***	***19.6***	***21.6***	***22.3***	***22.9***	***19.1***	***17.1***

Table S6a: Summary of September/October sequential sampling results used in data analyses. Samples that were above the lead AL are in bold, and samples that contained visible particulates are shaded yellow.

Sept/Oct Sequential Sampling Results by Site/Liter (µg/L)									
	Liter								
Site	12	13	14	15	16	17	18	19	20
01	13.9	14.1	11.7	--	--	--	--	--	--
03	--	--	--	--	--	--	--	--	--
05	--	--	--	--	--	--	--	--	--
06	--	--	--	--	--	--	--	--	--
07	12.7	9.29	6.52	6.03	--	--	--	--	--
08	12.8	9.34	7.93	6.27	--	--	--	--	--
09	--	--	--	--	--	--	--	--	--
10	--	**27.1**	**21.1**	10.7	--	--	--	--	--
11	--	--	--	--	--	--	--	--	--
12	6.98	3.28	2.04	--	--	--	--	--	--
13	--	--	--	--	--	--	--	--	--
17	2.84	2.62	2.59	--	--	--	--	--	--
18	--	--	--	--	--	--	--	--	--
19	--	--	--	--	--	--	--	--	--
21	--	--	--	--	--	--	--	--	--
22	--	--	--	--	--	--	--	--	--
23	--	--	--	--	--	--	--	--	--
24	12.8	15.3	15.4	--	--	--	--	--	--
26	--	--	--	--	--	--	--	--	--
27	**16.0**	12.8	9.24	--	--	--	--	--	--
28	--	--	--	--	--	--	--	--	--
29	11.1	10.1	9.21	9.01	9.29	8.99	8.77	8.73	8.39
30	--	--	--	--	--	--	--	--	--
31	4.17	--	--	--	--	--	--	--	--
32	--	--	--	--	--	--	--	--	--
33	12.4	11.5	10.1	--	--	--	--	--	--
34	--	--	--	--	--	--	--	--	--
35	--	--	--	--	--	--	--	--	--
36	--	--	--	--	--	--	--	--	--
Min	*2.84*	*2.62*	*2.04*	*6.03*	*9.29*	*8.99*	*8.77*	*8.73*	*8.39*
Max	***16.0***	***27.1***	***21.1***	*10.7*	*9.29*	*8.99*	*8.77*	*8.73*	*8.39*
Ave	*10.6*	*11.5*	*9.58*	*8.00*	*9.29*	*8.99*	*8.77*	*8.73*	*8.39*
90^{th} %ile	*13.9*	*15.3*	*15.4*	*10.7*	*9.29*	*8.99*	*8.77*	*8.73*	*8.39*

Table S6b: Summary of Supplemental September/October sequential sampling results not used in data analyses. Samples that were above the lead AL are in bold, and samples that contained visible particulates are shaded yellow.

Stagnation Times – Volunteers were asked to record the date and time water was last used, and the date and time when sampling began for each set of samples. Table S6c is a summary table which contains the stagnation times for the sequential samples, which is the amount of time the water sat motionless in the household prior to sample collection.

Sample Collection Stagnation Times			
June Sequential Sampling		Sept/Oct Sequential Sampling	
Site	Stagnation Time (hrs:mins)	Site	Stagnation Time (hrs:mins)
1	6:32	1	8:04
3	7:13	3	7:45
4	7:06	5	7:45
5	7:00	6	8:00
6	9:10	7	7:13
7	7:24	8	6:05
8	7:35	9	7:20
9	8:15	10	***
10	6:06	11	7:08
11	7:00	12	6:26
12	8:06	13	***
17	6:25	17	6:55
18	8:43	18	12:53
19	6:30	19	***
21	6:15	21	6:00
22	6:20	22	6:15
23	7:45	23	9:00
24	8:33	24	7:01
25	8:32	26	7:00
26	7:00	27	7:45
27	7:00	28	8:00
29	***	29	***
31	7:26	30	10:45
32	7:13	31	7:30
33	7:02	32	6:54
35	7:04	33	9:06
36	7:45	34	7:05
38	7:13	35	6:55
		36	8:47
***Volunteer did not record date/time the water was last used, but said it was the day before and was at least 6 hours before sampling.			

Table S6c: Summary of stagnation times for sequential sampling.

Seasonal Variability – Table S6d contains a site by site comparison of lead concentrations.

Seasonal Variability (Spring vs. Fall & Summer vs. Fall)					
First-Draw NHU	Sept/Oct > Mar/Apr	First-Draw PF	Sept/Oct > Mar/Apr	Sequential Samples	Sept/Oct > June
No. of Sample Pairs	28	No. of Sample Pairs	29	No. of Sample Pairs	285
No. Higher in Sept/Oct	19	No. Higher in Sept/Oct	20	No. Higher in Sept/Oct	156
% Higher in Sept/Oct	68%	% Higher in Sept/Oct	69%	% Higher in Sept/Oct	55%
First-Draw Samples: Mar/Apr vs. Sept/Oct (Same Site, Same First-Draw Protocol Compared)					
Sequential Samples: June vs. Sept/Oct (Same Site/Same Liter Compared)					

Table S6d: Seasonal variability effects observed.

Flushed sample results – The results of the flushed samples collected in September and October are tabulated in Table S7 by site. Most sites collected a 3 minute and 5 minute flushed sample. Some sites collected a 3, 5, and 7 minute flushed sample; and one site (site 29) collected a 3, 5, and 10 minute flushed sample, due to the length of the service line (159 ft / 48.5 m).

A flushed sample is collected by fully opening the sample tap and letting the water run for at least five minutes prior to a minimum 6 hour stagnation period. The date and time of the PF was recorded. After the minimum 6 hour stagnation period, and immediately before beginning the flushed sample collection, the date and time were again recorded and used as the start of sampling. The 3, 5, 7 and 10 minutes are measured from that start time, and water was not turned off between samples. For sequential sampling and flushed samples, the water was not turned off between samples.

EPA's current Public Notification Handbook includes instructions that advise residents to run the water between 30 and 45 seconds before collecting water for consumption if the water has not been used for an extended period of time. Running the water (flushing) for 45 seconds resulted in high lead levels at the tap for some sites. The flushed sampling results in this study indicate that EPA should develop a more appropriate flushing guidance, based on whether a home has a LSL or not, and the length of the LSL.

For homes with long LSLs, such as Site 29 (159 ft / 48.5 m), flushing may not be a practical way to reduce lead levels, as lead levels did not decline any further following 3, 5 and 10 minutes of flushing. In the case of site 29, residents would likely have a minimum of approximately 8 to 11 μg/L of lead in the drinking water for all water consumed, and should consider installing a water filter or using bottled water for drinking and cooking.

Flushed Sample Summary Table (µg/L)						
Site	Mar/Apr 2011 NHU 45sec	Mar/Apr 2011 PF 45sec	Sept/Oct 2011 3min	Sept/Oct 2011 5min	Sept/Oct 2011 7min	Sept/Oct 2011 10min
01	11.3	11.9	6.48	6.56	6.97	
03	12.0	6.71	3.78	2.93		
04	6.76	2.56				
05	13.2	14.1				
06	1.90	2.13				
07	**15.3**	**24.9**	5.49	5.46	5.32	
08	**32.2**	**28.0**	8.25	5.54	5.71	
09	**15.9**	**17.7**	14.3	7.23		
10	**25.0**	**21.6**	4.95	4.30	4.09	
11	4.13	5.30	1.75	1.69		
12	**17.2**	5.45	1.78	1.45	1.33	
13	3.50	2.94				
17	4.00	3.70	2.88	2.76	2.86	
18	9.57	12.4	4.15	3.71		
19	4.69	8.27				
20	2.80	2.54				
21	6.87	13.8				
22	9.19	7.93				
23	13.1	11.5	5.64	4.54		
24	6.10	4.98	6.38	12.4		
25	3.75	ND				
26	3.02	3.45	5.06	3.23		
27	4.53	3.76	15.0	14.1		
28	4.99	4.70	4.82	3.26		
29	13.5	**28.6**	11.9	10.9		10.8
30	12.5	6.52	5.80	4.82		
31	3.16	12.3	3.78	3.76		
32	2.29	7.82				
33	**16.4**	14.0	4.40	4.06		
34	1.51	3.30	1.83	1.75		
35	5.28	10.5	5.53	4.03		
36	11.1	8.76	7.19	5.29		
38	1.60	2.30				

NHU 45sec Samples were collected following the collection of the First-Draw NHU samples by running the water for 45 seconds following the collection of the First-Draw NHU sample.

PF 45sec Samples were collected following the collection of the First-Draw PF samples by running the water for 45 seconds following the collection of the First-Draw PF sample.

3min, 5min, 7min, and 10min flushed samples were collected after pre-flushing the tap for at least 5 minutes prior to the minimum 6 hour stagnation time during which no water was used in the home. Following the stagnation period and prior to sample collection, residents flushed the tap for 3 min to collect the 3min sample, and then an additional 2min for the 5min sample or 4min for the 7min sample. One site (site 29) had the longest lead service line so this site collected a 3 min, 5 min and 10min flushed sample (water was flushed for an additional 5 minutes following the collection of the 5min sample to collect the 10 min flushed sample). Water was not turned off in between samples to avoid the water hammer effect. Residents were instructed to have the bottles ready to insert under the faucet at the appropriate time.

Site 20 and Site 21 are the same residence. Site 20 was the upstairs bathroom and Site 21 was the kitchen sink. Note that neither the 45sec NHU nor PF samples from the upstairs tap captured any LSL water, while at least one of the kitchen tap samples did.

Table S7: Summary table of flushed sample results. Samples that were above the lead AL are in bold, and samples that contained visible particulates are shaded yellow.

Classification of Disturbed LSL Sites – A summary of the classification of each site as "disturbed", "undisturbed", or "indeterminate" is presented in Table S8, along with the number of samples collected per site and the number and percentage of sample results above the lead action level. The results from the "disturbed" and "undisturbed" sites are consistent with other research efforts showing that LSL disturbances result in higher lead levels[1-3].

Disturbed, Undisturbed and Indeterminate Site Summary								
Disturbed Sites	Total Samples Collected	# Samples Above AL (Disturbed)	Undisturbed Sites	Total Samples Collected	# Samples above AL (Undisturbed)	Indeterminate Sites	Total Samples Collected	# Samples above AL (Indeterminate)
01	27	16	03	27	4	12	27	17
05	27	2	04	14	0	21	27	7
07	27	11	06	27	0	33	27	6
08	27	19	11	27	0	---	---	---
09	27	15	13	15	0	---	---	---
10	27	15	18	27	0	---	---	---
17	27	3	19	27	0	---	---	---
27	27	5	22	27	0	---	---	---
28	15	0	23	27	0	---	---	---
29	27	15	24	27	0	---	---	---
30	15	4	25	14	0	---	---	---
31	27	10	26	27	0	---	---	---
35	27	2	32	27	2	---	---	---
---	---	---	34	15	0	---	---	---
---	---	---	36	27	0	---	---	---
---	---	---	38	16	0	---	---	---
Totals	**327**	**117**	**Totals**	**371**	**6**	**Totals**	**81**	**30**
% of samples above AL: 36%			**% of samples above AL: 2%**			**% of samples above AL: 37%**		

Table S8: Summary Table of Disturbed, Undisturbed and Indeterminate Sites, with the number and percentages of sample results above the lead AL for each site and each grouping.

Many direct LSL disturbances are localized to a specific segment of the LSL, and yet some sites have higher lead levels in sample liters over a significant portion of the LSL, not just in the immediate area of the LSL that was disturbed. A probable reason is that, except for the initial liter of water, each subsequent one-liter sample reflects both lead levels within the segment of the plumbing where the water stagnated as well as a contribution from the rest of the plumbing the water travelled through. For example, the fifth liter of water collected from a kitchen tap will not only capture the lead from the segment of LSL where the water stagnated, but it will also collect contributions from the plumbing downstream as the water passes through the remaining LSL and internal plumbing on the way to the kitchen tap. If the sample results only represented the portion of the plumbing where the water stagnated, it would be expected that a variety of metals would be found in the initial liters due to the presence of a variety of metallic plumbing materials and components, but only lead should be found in the LSL samples. In this study, a variety of metals was detected even in samples that represented LSL samples (Figure S6).

Specifically, for Site 9, information provided by the resident indicated that the internal pipe from the LSL to the kitchen tap was galvanized iron pipe. This was confirmed by the co-occurrence of higher levels of zinc and iron within the first liter of water in figure S6. There were no copper pipes in the home, so the presence of the copper is indicative of brass components (faucet, connectors, shut-off valve(s), and the water meter). Trace amounts of iron, zinc and copper are captured in the later liter samples as the water flows through the internal plumbing en route to the kitchen tap, along with traces of iron, potentially from the water main. It can reasonably be assumed that the same phenomenon occurred for lead. Disturbed areas of the LSL have damaged scale, which can expose water passing through them to fresh lead. Therefore, lead measured in any sample upstream of the damaged area may include lead contributions from the damaged area.

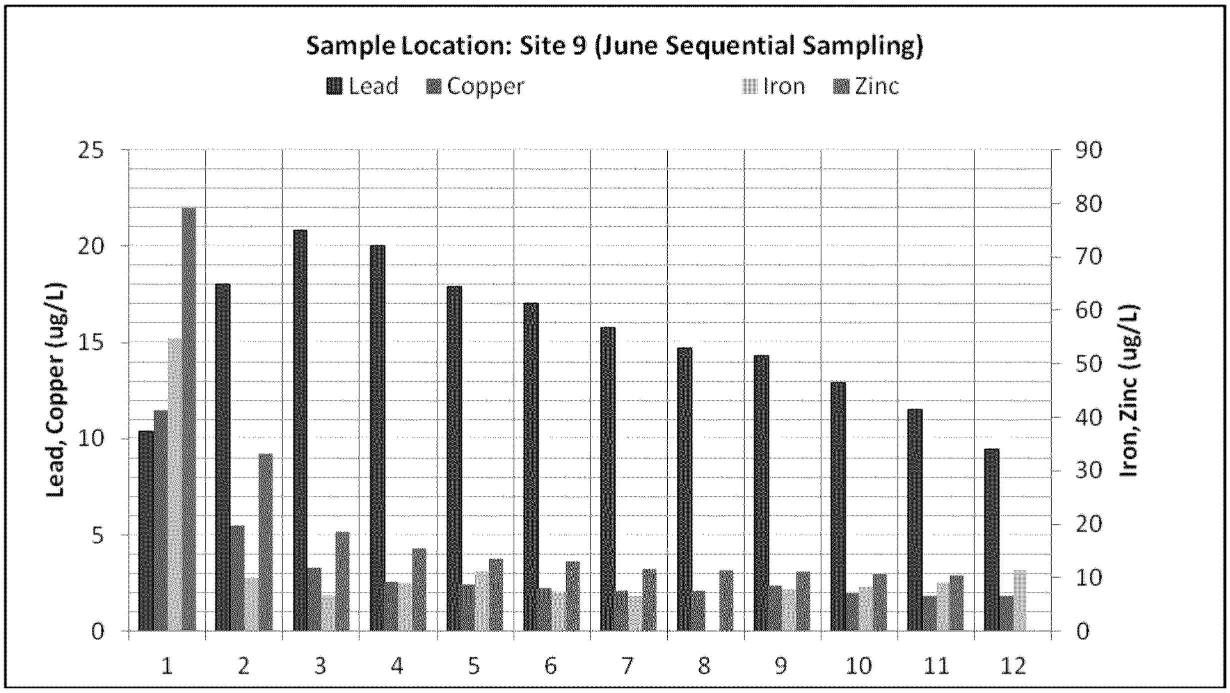


Figure S6: The LSL at Site 9 measures approximately 102 ft (31.1 m) from the water main to the meter. From the meter, there is approximately 13.5 ft (4.1 m) of 1 inch (2.54 cm) galvanized pipe to the kitchen tap.

Variability of lead levels in City B – A second city, City B, exceeded the lead AL during the July-Dec 2010 monitoring period, and was required to comply with the LSL replacement requirements in the LCR. Table S9 contains the compliance monitoring history for City B.

Monitoring Period Begin Date	Monitoring Period End Date	Number of Samples	Lead 90th Percentile Value (µg/l)
7/1/2011	12/31/2011	101	12
1/1/2011	6/30/2011	130	14
7/1/2010	12/31/2010	105	**23**
1/1/2009	12/31/2009	51	15
1/1/2008	12/31/2008	58	14
1/1/2007	12/31/2007	50	11
1/1/2006	12/31/2006	60	14
1/1/2005	12/31/2005	54	13
1/1/2004	6/30/2004	104	12
7/1/2003	12/31/2003	108	12
1/1/2002	12/31/2004	50	15
1/1/1999	12/31/1999	55	14
1/1/1998	12/31/1998	50	6
1/1/1997	12/31/1997	50	7
7/1/1996	12/31/1996	50	15
1/1/1996	6/30/1996	50	15
7/1/1992	12/31/1992	50	15
1/1/1992	6/30/1992	50	**21**

Table S9: City B 90th percentile compliance values (1992 – 2012). Samples that were above the lead AL are in bold.

The sampling instructions presented in Figure S7 are in accordance with the LCR, and were used to collect the LSL samples in City B, which has approximately 25,000 LSLs.

Instructions for Lead Sample Collection

1. Make sure the faucet used for sample collection is NOT attached to a water softener or any filtering device.
2. At bedtime, make sure the following rule is followed:
   - The water for the entire house, not just the faucet that is being used for collection, remains undisturbed for a period of at least six hours.
     - **No** faucets in the house are used, which includes the bath tub, shower and sinks.
     - The toilet is **not** flushed during this time period.
     - The water is **not** run for an ice maker.
3. When you are ready to collect the sample:
   - Make sure the sample is taken before any other water is used.
     - Open the collection container.
     - Turn on the **cold** water.
     - Allow the water to run until there is a significant change in temperature.
     - Fill the container to the shoulder.
     - Do **not** rinse the bottle out.
     - Immediately cap the sample container.
4. Fill out the enclosed chain of custody form and survey.
5. Fold and secure the chain of custody form and survey with a rubber band around the outside of the sample container.
   - Place the container outside where it was delivered.

❖ A city utilities employee will pick up the sample container. No one will enter your home. The sample must be left outside to be picked up.

Figure S7: LSL sampling instructions provided by City B to residents.

The sampling protocol used for collecting LSL samples ("allow the water to run until there is a significant change in temperature") can result in some sample results reflecting lead levels from internal plumbing rather than from within the LSLs.

The results from City B are presented below in Figure S8. Similar to the results presented for the study of Chicago, City B's results show significant variability in LSL lead levels across the system. Following the 2010 lead AL exceedance, the City B took 1,975 LSL samples, with a total of 1,762 results (89%) below the lead AL and 213 results (11%) above the lead AL. LSL results above the AL were significantly variable, ranging from 16 µg/L to 580 µg/L with a large number of sample results in exceedance of 50 µg/L.

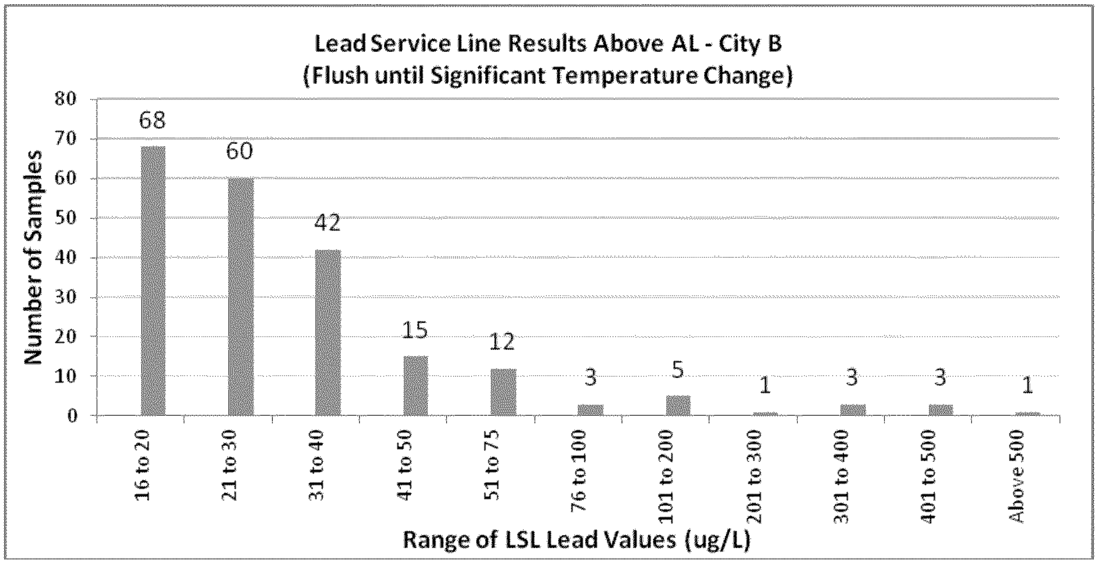
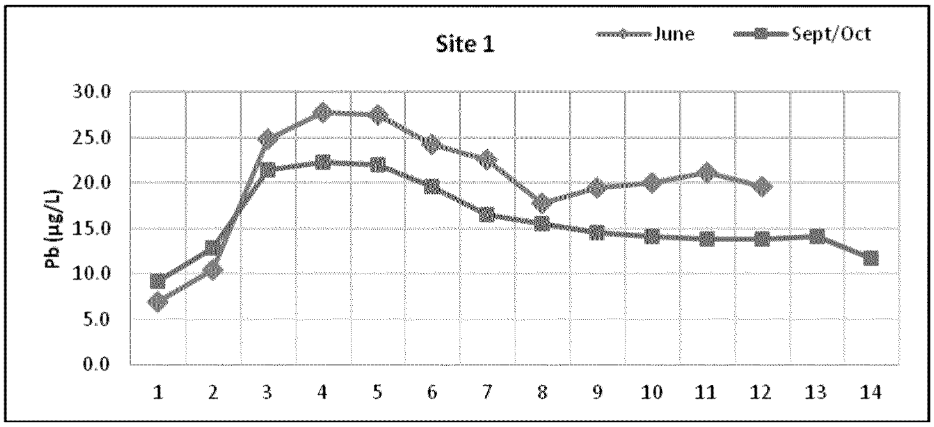


Figure S8: Range of lead values for City B LSL sampling results

Sequential Sampling Summary Graphs –The headers are color-coded based on whether the site has a disturbed LSL (red) or an undisturbed LSL (green). Sites for which this could not be determined (indeterminate sites) are color-coded orange. Water usage information is listed for each site. The samples which contained visible particulates are highlighted yellow, and the results that are above the lead AL are in bold text in the data tables. For sites that conducted sequential sampling in both June and Sept/Oct, the sequential sampling profiles were generally consistent during both sampling periods (see Figures S9 – S40).

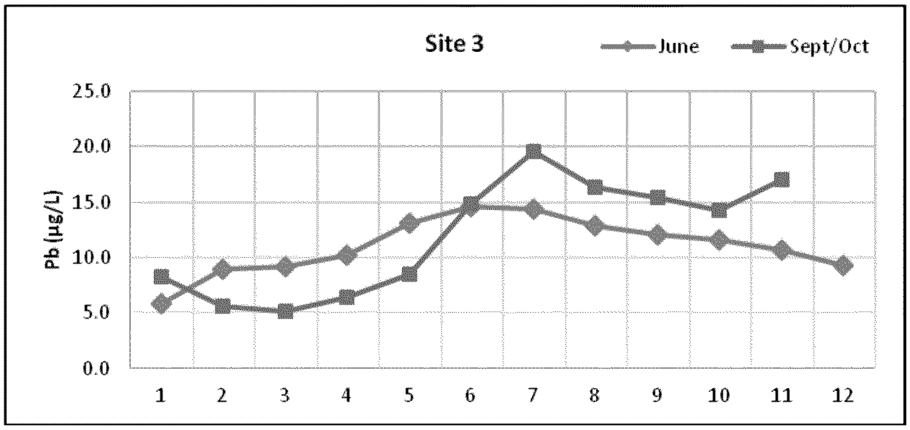
Site 1		
Liter	June	Sept/Oct
1	7.0	9.2
2	11	13
3	**25**	**21**
4	**28**	**22**
5	**28**	**22**
6	**24**	**20**
7	**23**	**17**
8	**18**	**16**
9	**20**	15
10	**20**	14
11	**21**	14
12	**20**	14
13		14
14		12



Disturbance(s): Water meter installed in 2010
Approximate LSL Length: 89 ft (27.1 m)
Ave Monthly Water Use: 3,444 gal. (13,037 L)

Figure S9: Sequential Lead Results - Sample Site #1 (June and Sept/Oct)

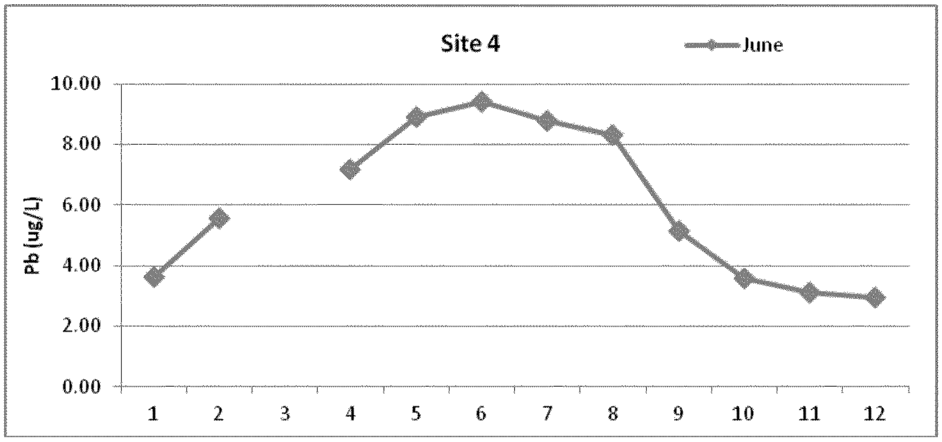
Site 3		
Liter	June	Sept/Oct
1	5.8	8.3
2	8.9	5.6
3	9.2	5.2
4	10	6.4
5	13	8.5
6	15	15
7	14	**20**
8	13	**16**
9	12	15
10	12	14
11	11	**17**
12	9.3	



Disturbance(s): No known disturbance
Approximate LSL Length: 73 ft (22.3 m)
Ave Monthly Water Use: Not metered

Figure S10: Sequential Lead Results - Sample Site #3 (June and Sept/Oct)

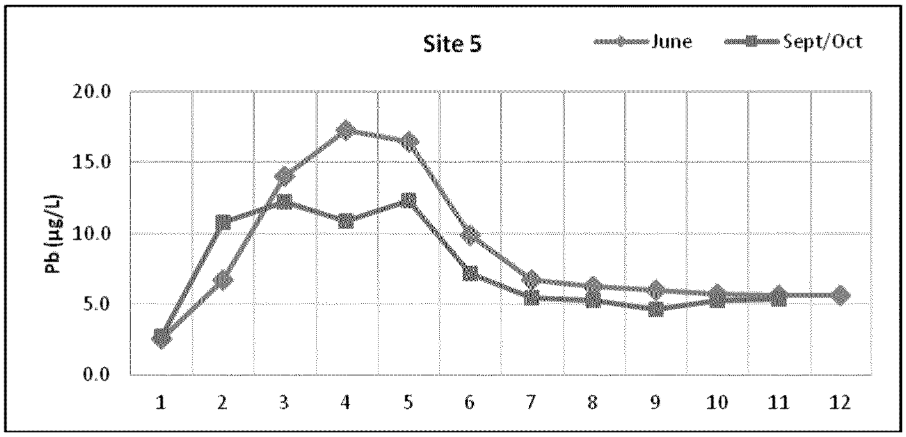
Site 4	
Liter	June
1	3.61
2	5.56
3	
4	7.17
5	8.90
6	9.41
7	8.78
8	8.30
9	5.14
10	3.59
11	3.11
12	2.96



Disturbance(s): No known disturbance
Approximate LSL Length: Unknown
Ave Monthly Water Use: Not metered

Figure S11: Sequential Lead Results - Sample Site #4 (June)

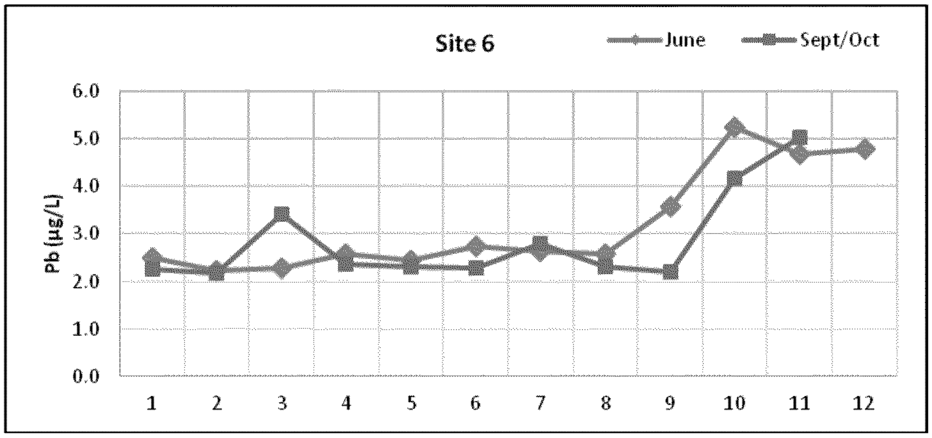
Site 5		
Liter	June	Sept/Oct
1	2.6	2.8
2	6.7	11
3	14	12
4	**17**	11
5	**17**	12
6	9.9	7.2
7	6.7	5.5
8	6.3	5.2
9	6.0	4.7
10	5.7	5.3
11	5.7	5.4
12	5.6	



Disturbance(s): Water meter installed in 2011
Approximate LSL Length: 80 ft (24.4 m)
Ave Monthly Water Use: 10,400 gal. (39,368 L)

Figure S12: Sequential Lead Results - Sample Site #5 (June and Sept/Oct)

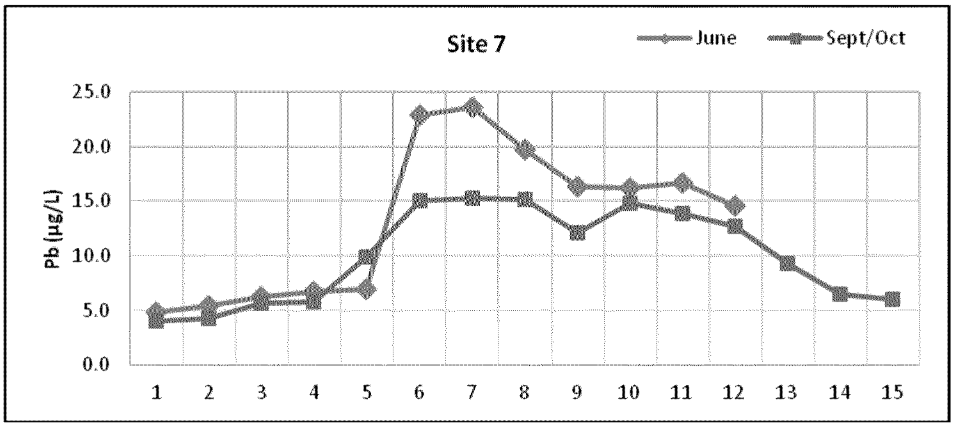
Site 6		
Liter	June	Sept/Oct
1	2.5	2.3
2	2.2	2.2
3	2.3	3.4
4	2.6	2.4
5	2.4	2.3
6	2.8	2.3
7	2.7	2.8
8	2.6	2.3
9	3.6	2.2
10	5.3	4.2
11	4.7	5.0
12	4.8	



Disturbance(s): No known disturbance
Approximate LSL Length: 60 ft (18.3 m)
Ave Monthly Water Use: Not metered

Figure S13: Sequential Lead Results - Sample Site #6 (June and Sept/Oct)

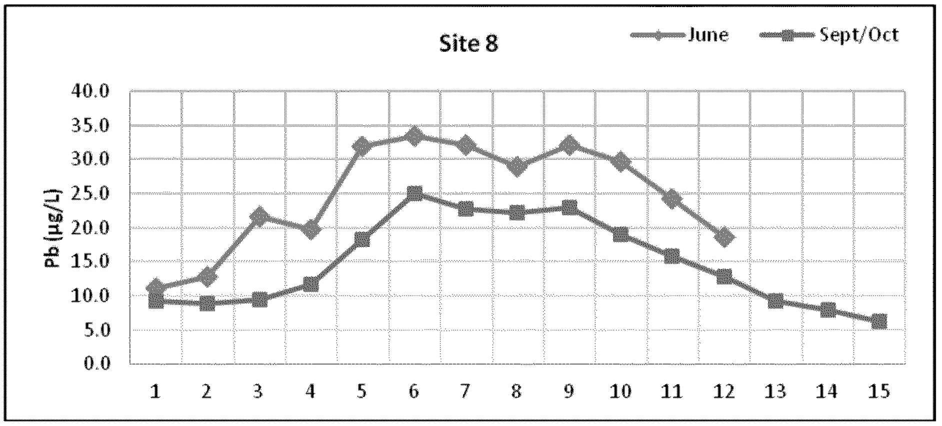
Site 7		
Liter	June	Sept/Oct
1	4.9	4.0
2	5.5	4.3
3	6.3	5.7
4	6.7	5.8
5	7.0	9.9
6	**23**	15
7	**24**	15
8	**20**	15
9	**16**	12
10	**16**	15
11	**17**	14
12	15	13
13		9.3
14		6.5
15		6.0



Disturbance(s): Street excavation, potential installation of Cu whip at service connection in 2008
Approximate LSL Length: 59+ ft (18.0+ m)
Ave Monthly Water Use: Not metered

Figure S14: Sequential Lead Results - Sample Site #7 (June and Sept/Oct)

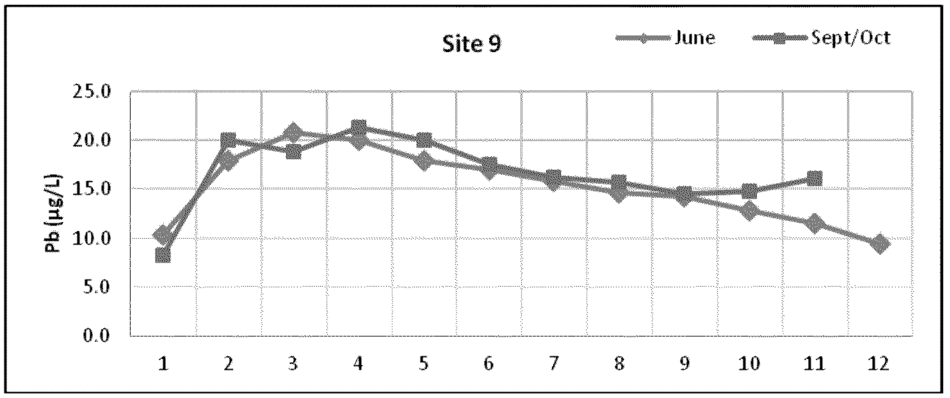
Site 8		
Liter	June	Sept/Oct
1	11	9.2
2	13	9.0
3	**22**	10
4	**20**	12
5	**32**	**18**
6	**34**	**25**
7	**32**	**23**
8	**29**	**22**
9	**32**	**23**
10	**30**	**19**
11	**24**	**16**
12	**19**	13
13		9.3
14		7.9
15		6.3



Disturbance(s): Leak in parkway, repaired roundway in 2005.
Approximate LSL Length: 57 ft (17.4 m)
Ave Monthly Water Use: Not metered

Figure S15: Sequential Lead Results - Sample Site #8 (June and Sept/Oct)

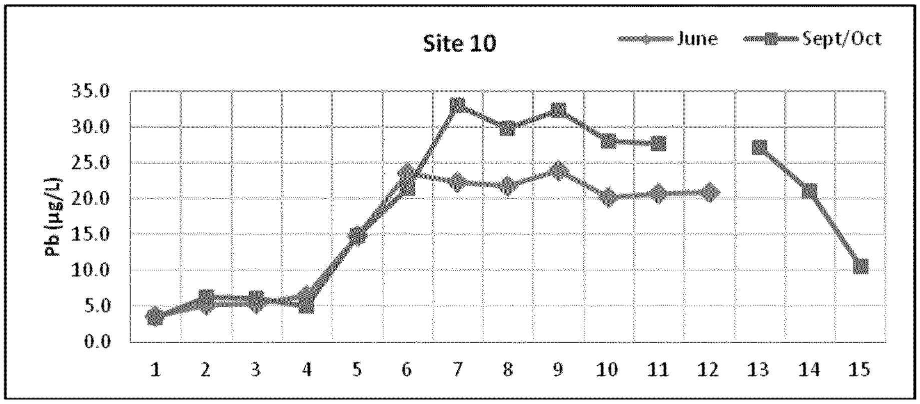
Site 9		
Liter	June	Sept/Oct
1	10	8.3
2	**18**	**20**
3	**21**	**19**
4	**20**	**21**
5	**18**	**20**
6	**17**	**18**
7	**16**	**16**
8	15	**16**
9	14	15
10	13	15
11	12	**16**
12	10	



Disturbance(s): Water meter installed in 2008.
Approximate LSL Length: 102 ft (31.1 m)
Ave Monthly Water Use: 3,190 (12,075 L) – In Sept 2011, usage was 24,000 gal. (90,850 L) due to hose left running for one or more days. In calculating the overall average, the Sept 2010 value of 8,000 gal. (30,283 L) was also used for Sept 2011 instead of the 24,000 gal. (90,850 L) value.

Figure S16: Sequential Lead Results - Sample Site #9 (June and Sept/Oct)

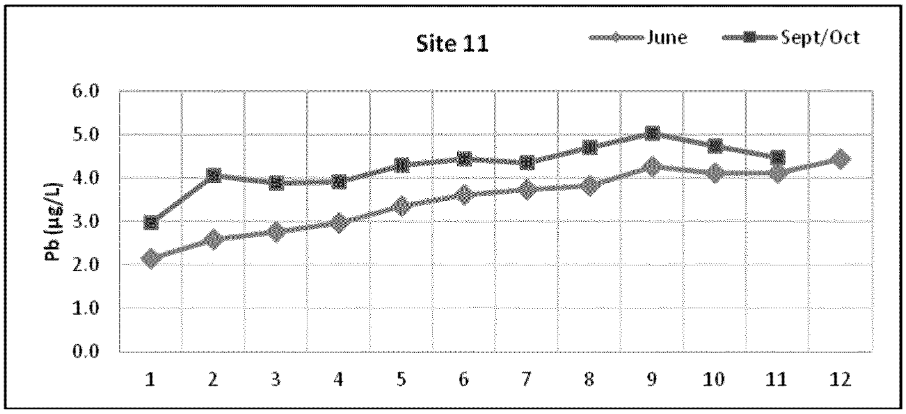
Site 10		
Liter	June	Sept/Oct
1	3.7	3.5
2	5.2	6.3
3	5.4	6.2
4	6.5	5.1
5	15	15
6	**24**	**21**
7	**22**	**33**
8	**22**	**30**
9	**24**	**32**
10	**20**	**28**
11	**21**	**28**
12	**21**	
13		**27**
14		**21**
15		11



Disturbance(s): Service leak repair, water meter installed in 2009.
Approximate LSL Length: 48+ ft (14.6 m)
Ave Monthly Water Use: 1,826 gal. (6,912 L)

Figure S17: Sequential Lead Results - Sample Site #10 (June and Sept/Oct)

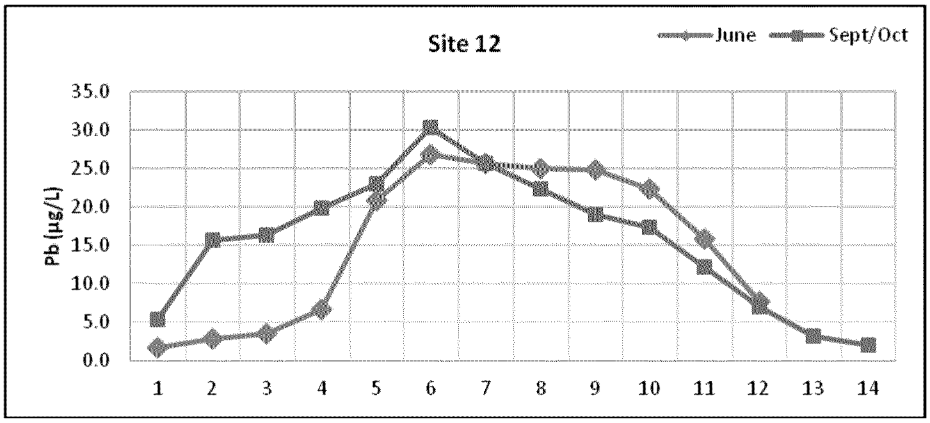
Site 11		
Liter	June	Sept/Oct
1	2.2	3.0
2	2.6	4.1
3	2.8	3.9
4	3.0	3.9
5	3.4	4.3
6	3.6	4.4
7	3.7	4.4
8	3.8	4.7
9	4.3	5.0
10	4.1	4.8
11	4.1	4.5
12	4.4	



Disturbance(s): No known disturbance
Approximate LSL Length: 50 ft (15.2 m)
Ave Monthly Water Use: Not metered

Figure S18: Sequential Lead Results - Sample Site #11 (June and Sept/Oct)

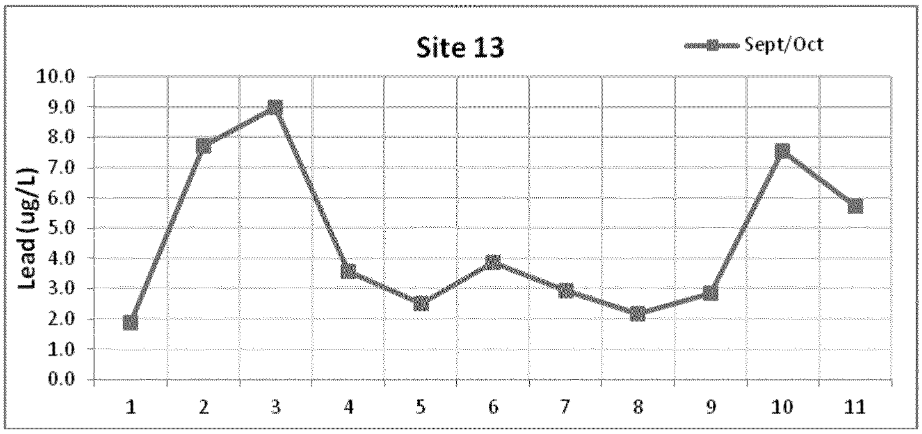
Site 12		
Liter	June	Sept/Oct
1	1.8	5.4
2	3.0	**16**
3	3.6	**16**
4	6.7	**20**
5	**21**	**23**
6	**27**	**30**
7	**26**	**26**
8	**25**	**22**
9	**25**	**19**
10	**22**	**17**
11	**16**	12
12	7.8	7.0
13		3.3
14		2.0



Disturbance(s): Indeterminate
Approximate LSL Length: 53 (16.2 m)
Ave Monthly Water Use: Not metered

Figure S19: Sequential Lead Results - Sample Site #12 (June and Sept/Oct)

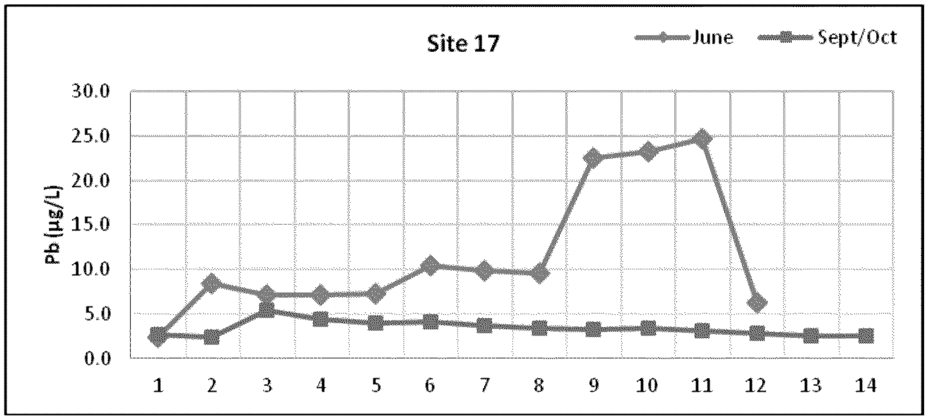
Site 13	
Liter	Sept/Oct
1	1.9
2	7.7
3	9.0
4	3.6
5	2.5
6	3.9
7	3.0
8	2.2
9	2.9
10	7.6
11	5.7



Disturbance(s): No known disturbance
Approximate LSL Length: 49+ ft (4.9 m)
Ave Monthly Water Use: Not metered

Figure S20: Sequential Lead Results - Sample Site #13 (Sept/Oct)

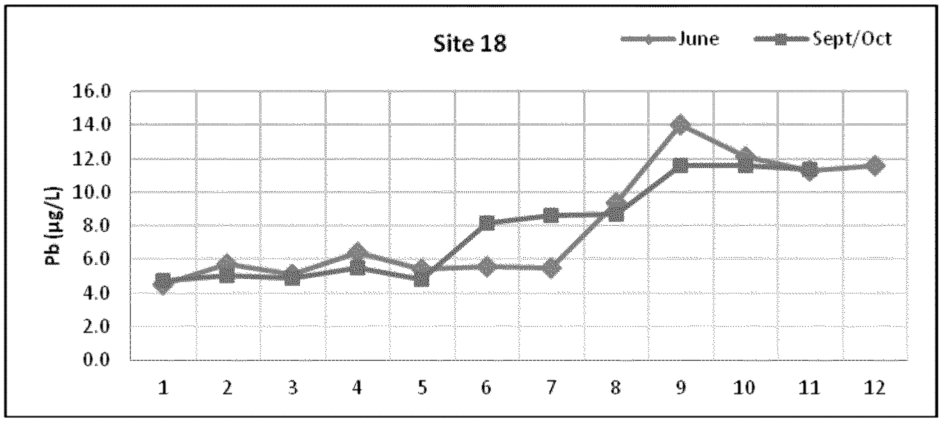
Site 17		
Liter	June	Sept/Oct
1	2.4	2.7
2	8.5	2.4
3	7.1	5.5
4	7.2	4.4
5	7.3	4.1
6	11	4.1
7	9.9	3.7
8	9.6	3.4
9	**23**	3.4
10	**23**	3.4
11	**25**	3.2
12	6.3	2.8
13		2.6
14		2.6



Disturbance(s): Meter replacement in 2008.
Approximate LSL Length: 58+ ft (17.7+ m)
Ave Monthly Water Use: 9,772 gal. (36,991 m)

Figure S21: Sequential Lead Results - Sample Site #17 (June and Sept/Oct)

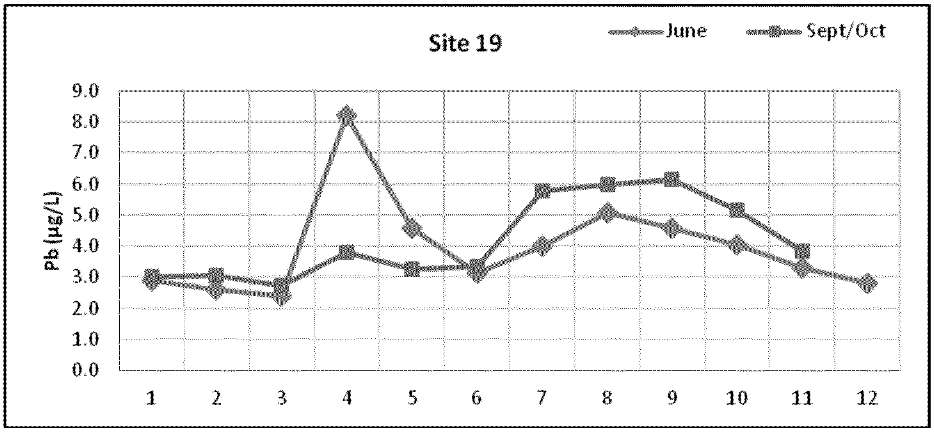
Site 18		
Liter	June	Sept/Oct
1	4.6	4.8
2	5.7	5.1
3	5.1	4.9
4	6.4	5.5
5	5.4	4.8
6	5.6	8.2
7	5.5	8.6
8	9.4	8.7
9	14	12
10	12	12
11	11	11
12	12	



Disturbance(s): No known disturbance
Approximate LSL Length: 76 ft (23.2 m)
Ave Monthly Water Use: Not metered

Figure S22: Sequential Lead Results - Sample Site #18 (June and Sept/Oct)

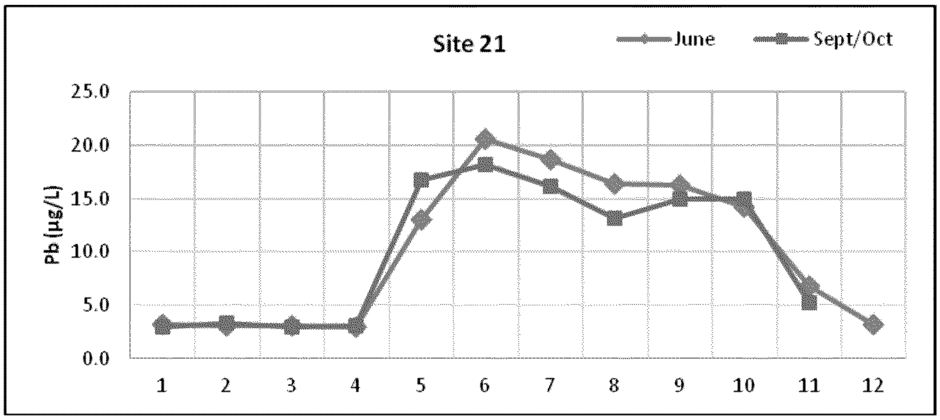
Site 19		
Liter	June	Sept/Oct
1	2.9	3.0
2	2.6	3.1
3	2.4	2.8
4	8.2	3.8
5	4.6	3.3
6	3.2	3.4
7	4.0	5.8
8	5.1	6.0
9	4.6	6.2
10	4.1	5.2
11	3.3	3.8
12	2.8	



Disturbance(s): No known disturbance
Approximate LSL Length: 63 ft (19.2 m)
Ave Monthly Water Use: Not metered

Figure S23: Sequential Lead Results - Sample Site #19 (June and Sept/Oct)

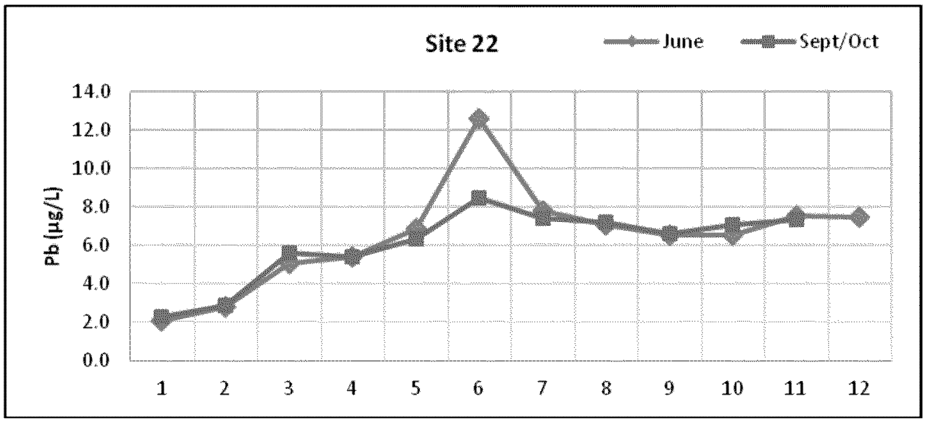
Site 21		
Liter	June	Sept/Oct
1	3.2	3.0
2	3.1	3.4
3	3.1	3.0
4	3.0	3.0
5	13	**17**
6	**21**	**18**
7	**19**	**16**
8	**16**	13
9	**16**	15
10	14	15
11	7.0	5.2
12	3.2	



Disturbance(s): Indeterminate
Approximate LSL Length: 46 ft (14.0 m)
Ave Monthly Water Use: Not metered

Figure S24: Sequential Lead Results - Sample Site #21 (June and Sept/Oct)

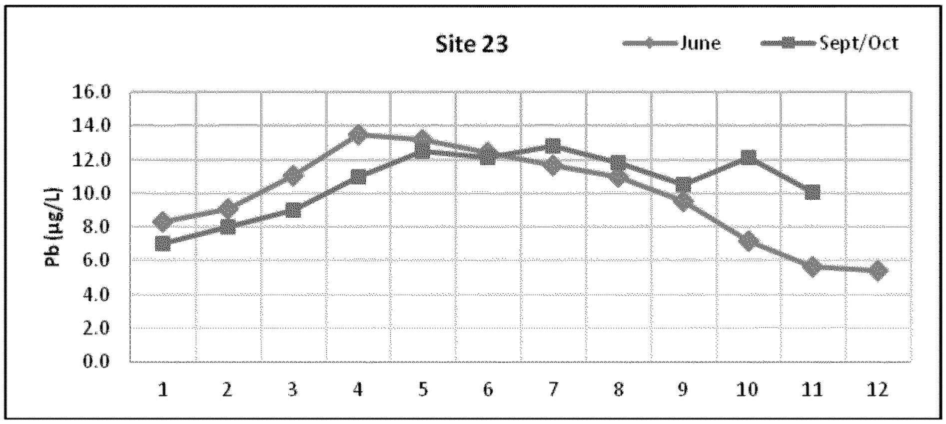
Site 22		
Liter	June	Sept/Oct
1	2.1	2.3
2	2.8	2.9
3	5.1	5.6
4	5.4	5.4
5	6.9	6.3
6	13	8.5
7	7.8	7.4
8	7.1	7.2
9	6.5	6.6
10	6.6	7.1
11	7.6	7.4
12	7.5	



Disturbance(s): No known disturbance
Approximate LSL Length: 65 ft (19.8 m)
Ave Monthly Water Use: Not metered

Figure S25: Sequential Lead Results - Sample Site #22 (June and Sept/Oct)

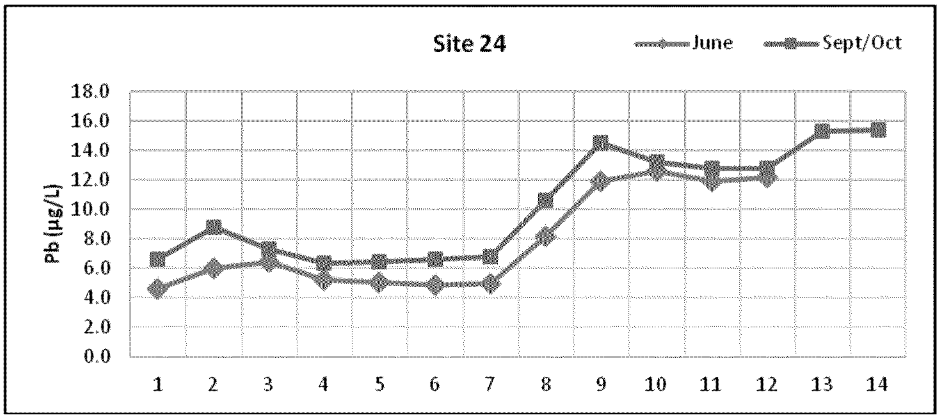
Site 23		
Liter	June	Sept/Oct
1	8.3	7.0
2	9.1	8.0
3	11	9.0
4	14	11
5	13	13
6	12	12
7	12	13
8	11	12
9	9.6	11
10	7.2	12
11	5.7	10
12	5.4	



Disturbance(s): No known disturbance
Approximate LSL Length: 66 ft (20.1 m)
Ave Monthly Water Use: Not metered

Figure S26: Sequential Lead Results - Sample Site #23 (June and Sept/Oct)

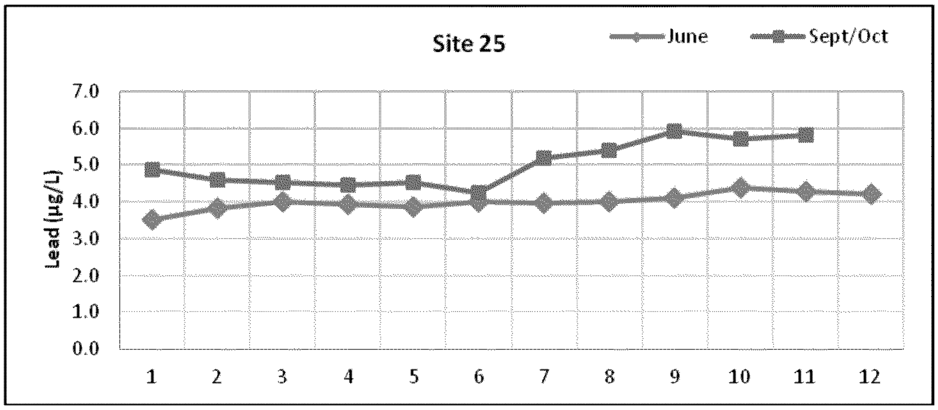
Site 24		
Liter	June	Sept/Oct
1	4.6	6.6
2	6.1	8.8
3	6.4	7.3
4	5.2	6.4
5	5.1	6.5
6	4.9	6.6
7	5.0	6.8
8	8.2	11
9	12	15
10	13	13
11	12	13
12	12	13
13		15
14		15



Disturbance(s): No known disturbance
Approximate LSL Length: 56 ft (17.1 m)
Ave Monthly Water Use: Not metered

Figure S27: Sequential Lead Results - Sample Site #24 (June and Sept/Oct)

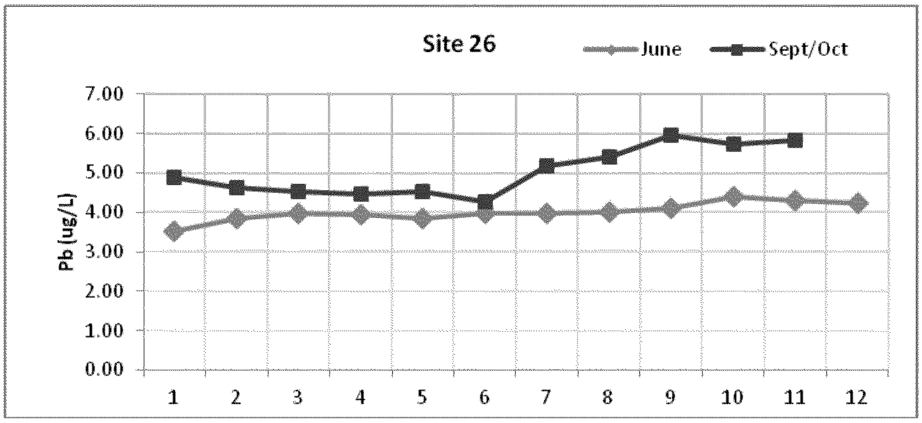
Site 25		
Liter	June	Sept/Oct
1	3.5	4.9
2	3.8	4.6
3	4.0	4.5
4	3.9	4.5
5	3.9	4.5
6	4.0	4.3
7	4.0	5.2
8	4.0	5.4
9	4.1	5.9
10	4.4	5.7
11	4.3	5.8
12	4.2	



Disturbance(s): No known disturbance
Approximate LSL Length: 70 ft (21.3 m)
Ave Monthly Water Use: Not metered

Figure S28: Sequential Lead Results - Sample Site #25 (June and Sept/Oct)

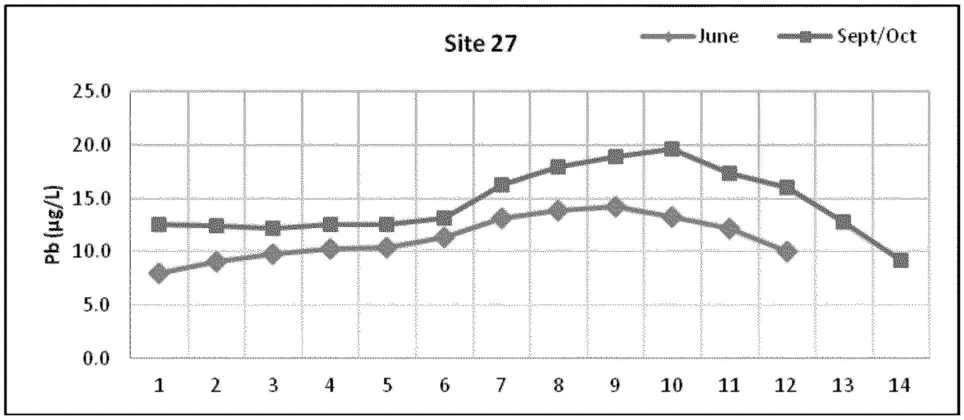
Site 26		
Liter	June	Sept/Oct
1	3.5	4.9
2	3.8	4.6
3	4.0	4.5
4	3.9	4.5
5	3.9	4.5
6	4.0	4.3
7	4.0	5.2
8	4.0	5.4
9	4.1	5.9
10	4.4	5.7
11	4.3	5.8
12	4.2	



Disturbance(s): No known disturbance
Approximate LSL Length: 66 ft (20.1 m)
Ave Monthly Water Use: Not metered

Figure S29: Sequential Lead Results - Sample Site #26 (June and Sept/Oct)

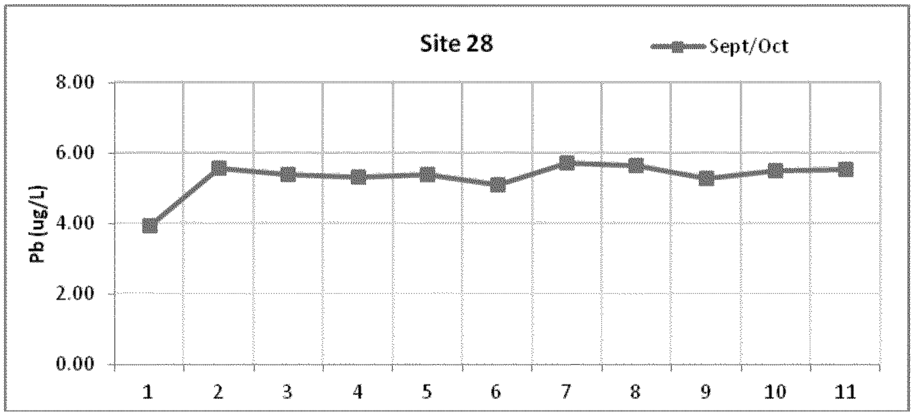
Site 27		
Liter	June	Sept/Oct
1	8.1	13
2	9.1	12
3	9.8	12
4	10	13
5	10	13
6	11	13
7	13	**16**
8	14	**18**
9	14	**19**
10	13	**20**
11	12	**17**
12	10	**16**
13		13
14		9.2



Disturbance(s): Meter replacement in 2010.
Approximate LSL Length: 47+ ft (14.3 m)
Ave Monthly Water Use: 4267 gal. (16,152 L)

Figure S30: Sequential Lead Results - Sample Site #27 (June and Sept/Oct)

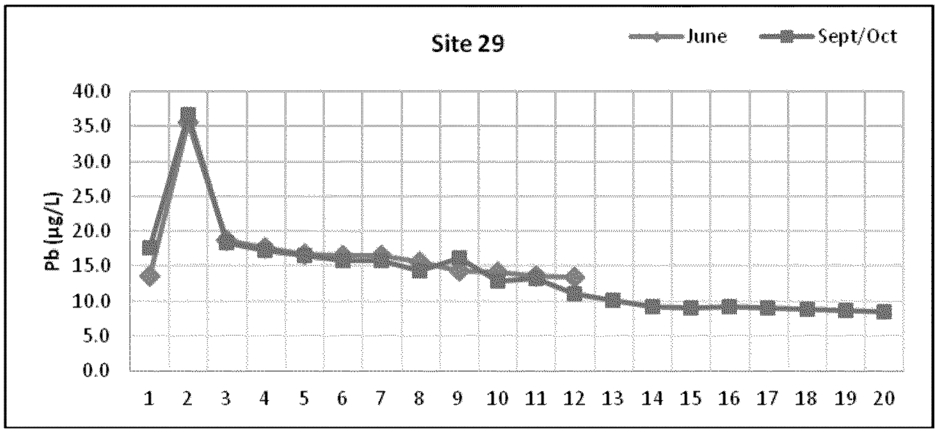
Site 28	
Liter	Sept/Oct
1	3.9
2	5.6
3	5.4
4	5.3
5	5.4
6	5.1
7	5.7
8	5.7
9	5.3
10	5.5
11	5.6



Disturbance(s): Meter replacement in 2009.
Approximate LSL Length: 61+ ft (18.6+ m)
Ave Monthly Water Use: 4273 gal. (16,175 L)

Figure S31: Sequential Lead Results - Sample Site #28 (Sept/Oct)

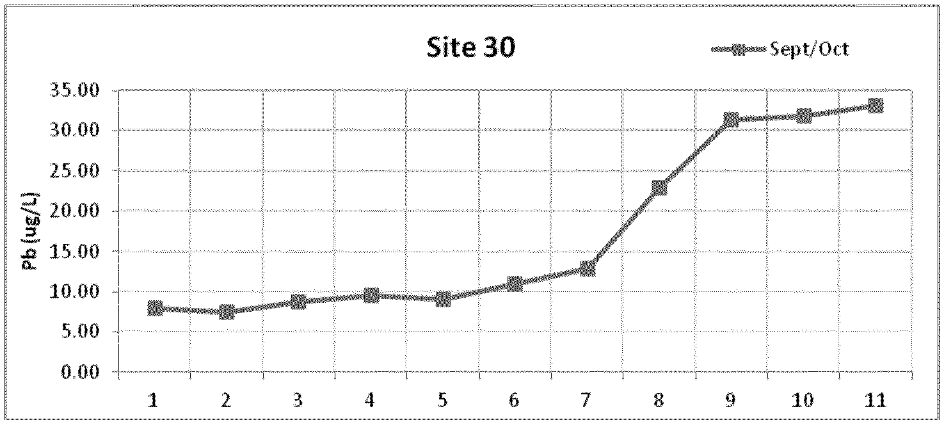
Site 29		
Liter	June	Sept/Oct
1	14	**18**
2	**36**	**37**
3	**19**	**18**
4	**18**	**17**
5	**17**	**17**
6	**17**	**16**
7	**17**	**16**
8	**16**	14
9	14	**16**
10	14	13
11	14	13
12	13	11
13		10
14		9.2
15		9.0
16		9.3
17		9.0
18		8.8
19		8.7
20		8.4



Disturbance(s): Probable Approximate LSL leak repair, meter installed in 2010.
Approximate LSL Length: 159 ft (48.5 m)
Ave Monthly Water Use: 1,438 gal. (5,443 L)

Figure S32: Sequential Lead Results - Sample Site #29 (June and Sept/Oct)

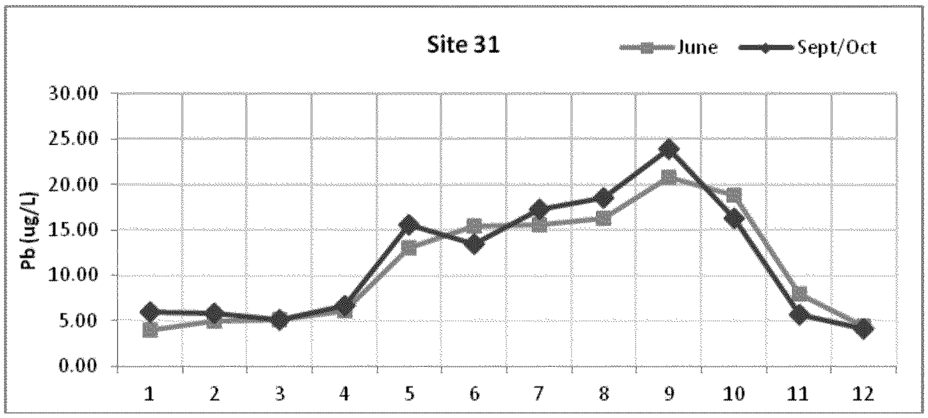
Site 30	
Liter	Sept/Oct
1	7.9
2	7.5
3	8.7
4	9.5
5	9.1
6	11
7	13
8	**23**
9	**31**
10	**32**
11	**33**



Disturbance(s): Broken water main in 2000, sidewalk replaced & street re-surfacing.
Approximate LSL Length: 49+ ft (14.9 m)
Ave Monthly Water Use: Not metered

Figure S33: Sequential Lead Results - Sample Site #30 (Sept/Oct)

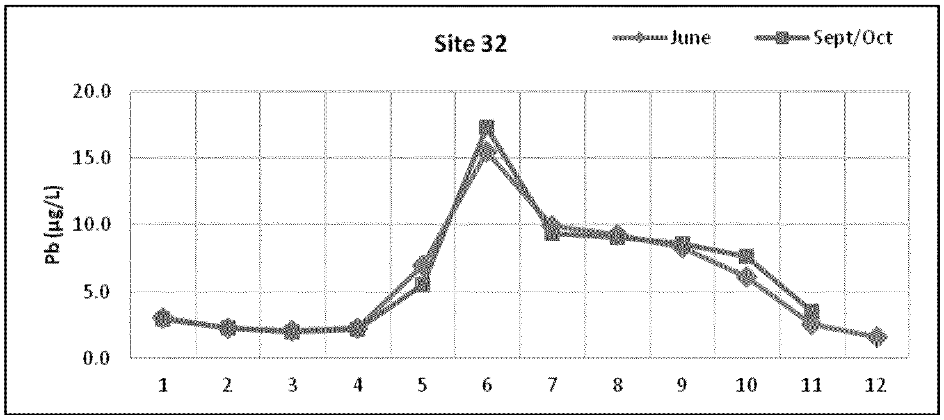
Site 31		
Liter	June	Sept/Oct
1	4.0	6.0
2	5.0	5.8
3	5.1	5.2
4	6.2	6.7
5	13	**16**
6	15	13
7	**16**	**17**
8	**16**	**19**
9	**21**	**24**
10	**19**	**16**
11	8	5.7
12	4.5	4.2



Disturbance(s): Approximate LSL leak repair in 2010.
Approximate LSL Length: 71+ ft (21.6+ m)
Ave Monthly Water Use: Not metered

Figure S34: Sequential Lead Results - Sample Site #31 (June and Sept/Oct)

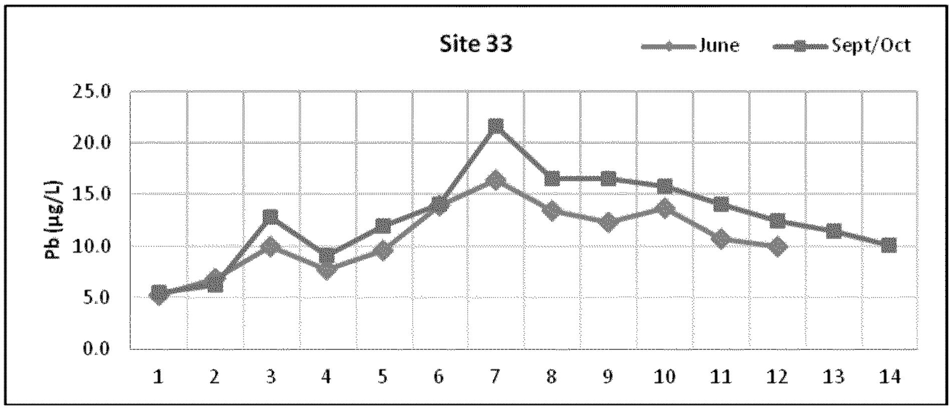
Site 32		
Liter	June	Sept/Oct
1	3.1	2.9
2	2.3	2.2
3	2.1	2.0
4	2.3	2.2
5	7.0	5.5
6	**16**	**17**
7	9.9	9.4
8	9.3	9.1
9	8.3	8.6
10	6.1	7.6
11	2.6	3.5
12	1.7	



Disturbance(s): No known disturbance
Approximate LSL Length: 43 ft (13.1 m)
Ave Monthly Water Use: Not metered

Figure S35: Sequential Lead Results - Sample Site #32 (June and Sept/Oct)

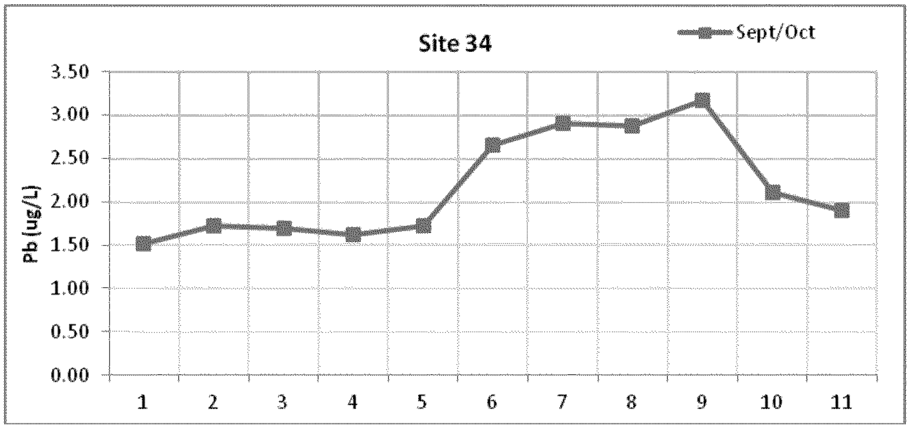
Site 33		
Liter	June	Sept/Oct
1	5.2	5.5
2	6.9	6.3
3	10	13
4	7.7	9.1
5	9.6	12
6	14	14
7	**16**	**22**
8	14	**17**
9	12	**17**
10	14	**16**
11	11	14
12	10	12
11		12
12		10



Disturbance(s): Indeterminate
Approximate LSL Length: 43+ ft (13.1 m)
Ave Monthly Water Use: Not metered

Figure S36: Sequential Lead Results - Sample Site #33 (June and Sept/Oct)

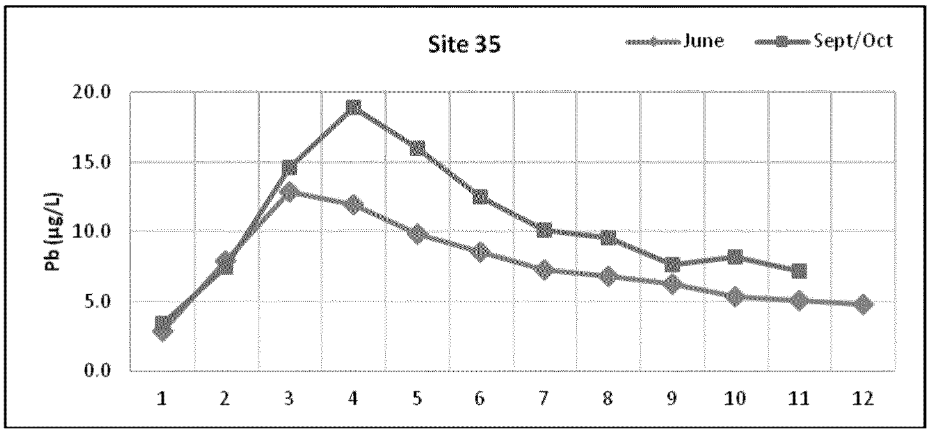
Site 34	
Liter	Sept/Oct
1	1.5
2	1.7
3	1.7
4	1.6
5	1.7
6	2.7
7	2.9
8	2.9
9	3.2
10	2.1
11	1.9



Disturbance(s): No known disturbance
Approximate LSL Length: Unknown
Ave Monthly Water Use: Not metered

Figure S37: Sequential Lead Results - Sample Site #34 (Sept/Oct)

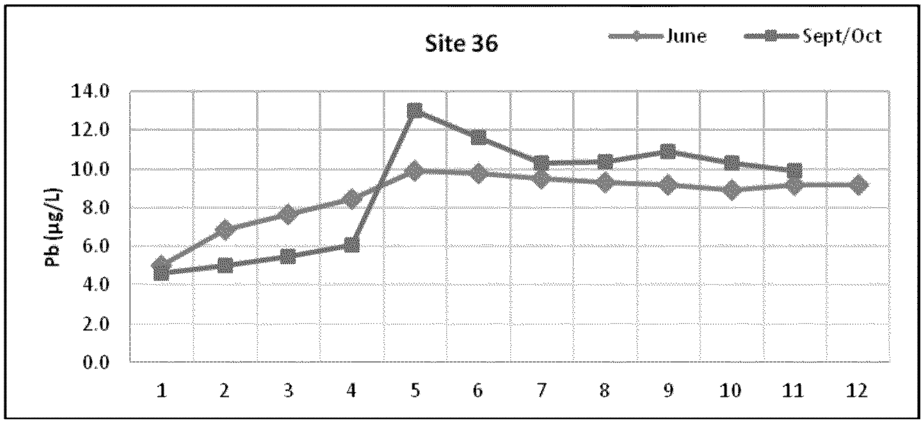
Site 35		
Liter	June	Sept/Oct
1	2.9	3.4
2	7.9	7.4
3	13	15
4	12	**19**
5	9.9	**16**
6	8.6	13
7	7.3	10
8	6.8	9.6
9	6.2	7.6
10	5.3	8.2
11	5.0	7.2
12	4.8	



Disturbance(s): Meter installed in Aug 2011 (between June and Sept/Oct sampling).
Approximate LSL Length: 80 ft (24.4 m)
Ave Monthly Water Use: 4,667 gal. (17,667 L) – Data available only for Aug-Oct 2011

Figure S38: Sequential Lead Results - Sample Site #35 (June and Sept/Oct)

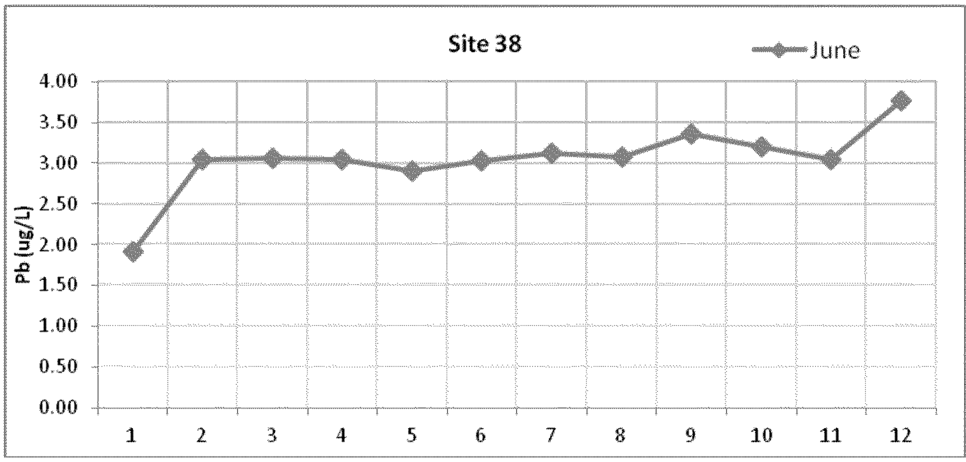
Site 36		
Liter	June	Sept/Oct
1	5.0	4.6
2	6.9	5.0
3	7.7	5.5
4	8.5	6.1
5	9.9	13
6	9.8	12
7	9.5	10
8	9.3	10
9	9.2	11
10	8.9	10
11	9.2	9.9
12	9.2	



Disturbance(s): No known disturbance
Approximate LSL Length: 83+ ft (25.3 m)
Ave Monthly Water Use: Not metered

Figure S39: Sequential Lead Results - Sample Site #36 (June and Sept/Oct)

Site 38	
Liter	June
1	1.9
2	3.0
3	3.1
4	3.0
5	2.9
6	3.0
7	3.1
8	3.1
9	3.4
10	3.2
11	3.0
12	3.8



Disturbance(s): No known disturbance
Approximate LSL Length: 51 ft (15.5 m)
Ave Monthly Water Use: Not metered

Figure S40: Sequential Lead Results - Sample Site #38 (June)

Sampling collection and reporting instructions and forms

March/April sampling – The sampling instructions and forms below were used in the March/April sampling. Sampling was scheduled to conclude in March, but the sampling ran into April. As a result of the instructions below, some volunteers sampled one day at the kitchen tap and one day at the bathroom tap. The intent was to have all samples collected from the same tap, so volunteers that split the samples were asked to collect replacement samples so that a complete set of four samples was collected at the same tap. We chose the kitchen tap, and all samples collected thereafter were also collected at the kitchen tap. In addition, the 45-second flushed sampling protocol was not used after the March/April sampling due to the complication with corroded galvanized pipe.

General Sampling Instructions

You will be taking a total of 8 samples for this study. One set of 4 samples will be taken in March 2011 and one set of 4 samples (using the same instructions) will be taken in August 2011.

General Instructions for all four samples of a set
Sample #1 and Sample #2 must be collected one after another on the same day.
Sample #3 and Sample #4 must also be collected one after another on the same day, and within the same week as Sample #1 and Sample #2.

All samples should be collected from taps that are generally used by your household for drinking water. Do not collect samples from a taps that have not been used within the last 24 hours. Use a kitchen or bathroom cold-water faucet for your sampling.

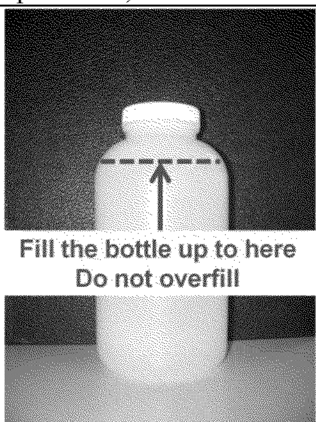
Do not collect samples from a tap that has a water filter or is connected to a water softener. If you have a water softener or water filter on your kitchen tap, collect your sample from a bathroom tap that is not attached to the water softener or water filter, if possible.

Instructions for Collecting Sample #1

Important: Please make sure you use the bottle labeled 'Sample #1' for your first sample!

Collecting Sample #1: The first sample is to be collected after water throughout the household *has not been used for a minimum of 6 hours* (example: midnight to 6am). During these 6 hours, do not flush toilets, shower, or run water from other faucets. The best time to collect samples is either:
1) First thing in the morning, before any water is used in the household; or 2) Immediately upon returning from work, and prior to using any water, as long as water has not been used in the household during the day.

1. When you are ready to collect your first sample, use the sample bottle labeled 'Sample #1'.
2. Do not run any water from the tap before collecting the first sample.
3. Place the opened sample bottle below the faucet and gently open the cold water tap.
4. Fill the sample bottle as you would normally fill a glass of water for drinking, up to the neck of the bottle (see photographs below) and turn off the water. Tightly cap the sample bottle.



Instructions for Collecting Sample #2

Important: Please make sure you use the bottle labeled 'Sample #2' for your second sample!

Collecting Sample #2: This sample is to be collected from the same faucet as Sample #1, immediately after collecting Sample #1.

1. Immediately after collecting Sample #1, run the water for 45 seconds. Shut off the water, and place the opened

sample bottle (labeled Sample #2) below the faucet and gently open the cold water tap.

2. Fill the sample bottle as you would normally fill a glass of water for drinking, up to the neck of the bottle (see photographs on first page) and turn off the water. Tightly cap the sample bottle.

Instructions for Collecting Sample #3

Important: Please make sure you use the bottle labeled 'Sample #3' for your third sample!

Collecting Sample #3: Collect on a different day in the same week as Samples #1 & #2.

1. *Before* letting the water sit for a minimum of 6 hours, run the water from the faucet for 5 minutes at a high rate, and then do not use any water in the household for at least 6 hours after that (Example: Run the water for 5 minutes at midnight before going to bed, and then do not use any water in the household until collecting the third sample at 6 am the following morning).
2. Do not run any more water from the tap before collecting the third sample. Place the opened sample bottle below the faucet and gently open the cold water tap.
3. Fill the sample bottle as you would normally fill a glass of water for drinking, up to the neck of the bottle (see photographs on first page) and turn off the water. Tightly cap the sample bottle.

Instructions for Collecting Sample #4

Important: Please make sure you use the bottle labeled 'Sample #4' for your fourth sample!

Collecting Sample #4: This sample is to be collected from the same faucet as Sample #3.

1. Immediately after collecting Sample #3, run the water for 45 seconds. Shut off the water, and place the opened sample bottle (labeled Sample #4) below the faucet and gently open the cold water tap.
2. Fill the sample bottle as you would normally fill a glass of water for drinking, up to the neck of the bottle (see photographs on first page) and turn off the water. Tightly cap the sample bottle.

Figure S41: March/April sampling instructions.

Sample Collection and Reporting Page

Sample Reporting – Sample #1 | **EPA Use: Visible Particulate? Yes ☐ No ☐**

Sample ID (from Sample Bottle #1): ______________ Date/time Sample #1 was collected: ____________________

Volunteer ID: __________________ Sampling Location: Kitchen Faucet ☐ Bathroom Faucet ☐

Date/time the water was last used in household before collecting Sample #1: _________________________________

Was sample #1 collected from a faucet that has a water softener or water filter? Yes ☐ No ☐

Sample Reporting – Sample #2 | **EPA Use: Visible Particulate? Yes ☐ No ☐**

Sample ID (from Sample Bottle #2): ____________ Date/time Sample #2 was collected: ____________________

Volunteer ID: ___________________ Sampling Location: Kitchen Faucet ☐ Bathroom Faucet ☐

Date/time the water was last used in household before collecting Sample #2: _________________________________

Was Sample #2 collected from the same faucet as Sample #1: Yes ☐ No ☐

Sample Reporting – Sample #3 | **EPA Use: Visible Particulate? Yes ☐ No ☐**

Sample ID (from Sample Bottle #3): ______________ Date/time Sample #3 was collected: ____________________

Volunteer ID: __________________ Sampling Location: Kitchen Faucet ☐ Bathroom Faucet ☐

Date/time the faucet was flushed before collecting Sample #3: _________________________________

Was sample #3 collected from a faucet that has a water softener or water filter? Yes ☐ No ☐

Sample Reporting – Sample #4 | **EPA Use: Visible Particulate? Yes ☐ No ☐**

Sample ID (from Sample Bottle #4): _____________ Date/time Sample #4 was collected: ____________________

Volunteer ID: ___________________ Sampling Location: Kitchen Faucet ☐ Bathroom Faucet ☐

Date/time the faucet was flushed before collecting Sample #4: _________________________________

Was Sample #4 collected from the same faucet as Sample #3: Yes ☐ No ☐

Have there been any plumbing repairs or plumbing work done within the household during the last six months (including installation of new faucets)? Yes ☐ No ☐

If yes, explain briefly (*Example – 'New faucet installed one week ago'*):

FOR EPA USE: Samples received by ______________________ Date/Time: _____________________

Samples transferred to Region 5 Laboratory by ______________________ Date/Time: ___________________

Volunteer Certification: I have read the sampling instructions and have collected the samples in accordance with the instructions provided.

_______________________________________ *OR* _____________________________

Signature/Date ***Volunteer ID/Date***

Figure S42: March/April sample collection and reporting form.

Sequential Sampling Instructions for June – The sampling instructions and forms below were used in the June sequential sampling.

Sequential Sampling Instructions

Please read all instructions before beginning your sampling

General Information

•Use only the kitchen faucet for all of these samples.

•Use only **cold water** and open the cold water tap all the way when filling the bottles.

•Fill each bottle to the top of the label on the sample bottle.

Sampling Instructions

•The night before sampling (right before everyone goes to bed) run the water from the kitchen tap for at least 5 minutes. Write down the date/time you finished running the water on the form on the back side of this page.

•The water must sit motionless in the home plumbing for at least 6 hours before collecting the samples so do not use water in the home after you finished running the water and until all samples are collected the following morning. Showering, flushing toilets, or other water use will affect the sampling results. It may help to tape a sign in the kitchen and bathrooms with a reminder not to use the water, in case people forget.

• The bottles are numbered, and it is very important to collect them in order (Sample 1 first, Sample 2 second, etc.).

•In the morning, when you are ready to sample, place the open bottles in order by sample number. You will be collecting the samples without shutting off the water in between samples, so you should remove the caps from all bottles so that you have all of the bottles ready to fill. You can put the caps on after all samples have been collected. Try not to let any water spill in between samples.

•Write down the date/time right before you sample on the form on the back side of this page.

•Begin by placing the Sample 1 bottle under the faucet and open the **cold water** slowly until the faucet is fully open. While one bottle is filling, grab the next bottle so that you are ready to move it under the faucet quickly.

•Once the bottle is filled to the top of the label, quickly place the Sample 2 bottle under the faucet, and continue until you have filled all sample bottles.

Sequential Sampling – Sample Collection and Reporting Form

Volunteer ID: ______________

Sampling Information

Date/time the water was last used in household (the night before collecting the samples): ______________________________

Date/Time Volunteer Began Collecting Samples: ____________________________

Were All Samples Collected from the Kitchen Tap? Yes ☐ No ☐

FOR EPA USE: Samples received by ____________________________ **Date/Time:** ________________

Samples transferred to Region 5 Laboratory by ______________________ **Date/Time:** ________________

EPA Use: Visible Particulate in any samples? Yes ☐ No ☐ If Yes – List Samples With Particulate ________________________________

Volunteer Certification: I have read the sampling instructions and have collected the samples in accordance with the instructions provided.

______________________________________ ***OR*** ______________________________

Signature/Date ***Volunteer ID/Date***

Figure S43: June sampling instructions and sample collection and reporting form.

Sampling instructions for September/October – In the final round of sampling, the number and type of samples was customized to each site and sites collected 3 days of sampling. The instructions below were for a site collecting one NHU First-draw sample, 11 sequential samples and a 2 flushed samples. Some sites collected additional sequential samples and some collected 3 flushed samples instead of two.

Sampling Instructions
Please read all instructions before you start sampling.
General Information ☐ Use **only the kitchen faucet** for all of these samples. ☐ Use **only cold water**. ☐ Open the cold water tap all the way when filling the bottles. ☐ Fill each bottle to the top of the label on the sample bottle.
Sampling Instructions ☐ There are three different sets of samples for you to collect (Sample Set #1, #2 and #3). ☐ Each set will be taken on a different day. (The three sampling sets do not have to be taken on three days in a row.) ☐ A section of the reporting form (attached) needs to be filled in for each day of sampling.
A) Sample Set #1 (1 bottle, Blue Label) 1. The water must sit motionless in the home plumbing for at least 6 hours before collecting the sample. Typically, the night before taking the sample, make sure that no one uses water in the home until you collect the sample from the kitchen the following morning. 2. In the morning, when you are ready to sample, write down the date/time on the attached form. 3. Fill up the bottle with the BLUE LABEL. That's it for collecting the first sample set.
B) Sample Set #2 "Sequential Sampling" (11 bottles, WHITE LABELS) 1. The night before sampling (right before everyone goes to bed) run the water from the kitchen tap for at least 5 minutes. Write down the date/time you finished running the water on the form. After running the water for 5 minutes, it should sit motionless in the home plumbing for at least 6 hours. 2. In the morning, your first water usage should be collecting eleven samples in a row (one after another). Use the bottles with the WHITE LABELS. The samples should be collected without shutting off the water in between samples. To do this, remove the caps from all eleven bottles before you turn on the water. 3. Place the eleven open bottles in order by sample number before you start collecting the samples Try not to waste water in between the samples. You can put the caps on after all 11 samples have been collected. The bottles are numbered Seq 01, to Seq 11. **It is very important to collect the samples in order** (Seq 01 first, Seq 02 second, etc.). 4. Use the attached reporting form to note the date and time that you started taking the sample set.
C) Sample Set #3 (2 Bottles, GREEN LABEL and YELLOW LABEL) 1. The night before sampling (right before everyone goes to bed) run the water from the kitchen tap for at least 5 minutes. Write down the date/time you finished running the water on the form. After running the water for 5 minutes, it should sit motionless in the home plumbing for at least 6 hours. 2. In the morning, when you are ready to sample, write down the date/time on the attached reporting form. 3. Run the water for 3 minutes, then collect a sample in the jar with the GREEN LABEL. Continue to let the water run for an additional 2 minutes (for a total of 5 minutes), and collect the final sample in the bottle with the YELLOW LABEL.

Figure S44: Sept/Oct sampling instructions.

Sample Collection and Reporting – Sampling set # 1 (Blue label)

Volunteer ID: ________________

Sampling Information

Date/time the water was last used in household (the night before collecting the samples): ______________________________

Date/Time Volunteer Began Collecting Samples: __________________ ________

Were All Samples Collected from the Kitchen Tap? Yes ☐ No ☐

FOR EPA USE: Samples received by ___________________________ **Date/Time:** _________________

Samples transferred to Region 5 Laboratory by _____________________ **Date/Time:** _________________

EPA Use: Visible Particulate in any samples? Yes ☐ No ☐ **If Yes – List Samples With Particulate** ______________________________

Sample Collection and Reporting - Sampling set # 2 (11 samples, White labels)

Volunteer ID: ________________

Sampling Information

Date/time the water was last used in household (the night before collecting the samples): ______________________________

Date/Time Volunteer Began Collecting Samples: ___________________________

Were All Samples Collected from the Kitchen Tap? Yes ☐ No ☐

FOR EPA USE: Samples received by ___________________________ **Date/Time:** _________________

Samples transferred to Region 5 Laboratory by _____________________ **Date/Time:** _________________

EPA Use: Visible Particulate in any samples? Yes ☐ No ☐ **If Yes – List Samples With Particulate** ______________________________

Sample Collection and Reporting - Sampling set # 3 (Green and Yellow labels)

Volunteer ID: ________________

Sampling Information

Date/time the water was last used in household (the night before collecting the samples): ______________________________

Date/Time Volunteer Began Collecting Samples: ___________________________

Were All Samples Collected from the Kitchen Tap? Yes ☐ No ☐

FOR EPA USE: Samples received by ___________________________ **Date/Time:** _________________

Samples transferred to Region 5 Laboratory by _____________________ **Date/Time:** _________________

EPA Use: Visible Particulate in any samples? Yes ☐ No ☐ **If Yes – List Samples With Particulate** ______________________________

Volunteer Certification: I have read the sampling instructions and have collected the samples in accordance with the instructions provided.

____ ***OR*** ______________________________

Signature/Date ***Volunteer ID/Date***

Figure S45: Sept/Oct sample collection and reporting form.

Literature Cited/References

1. Triantafyllidou, S.; Edwards, M., Galvanic corrosion after simulated small-scale partial lead service line replacements. *Journal American Water Works Association* **2011,** *103*, (9), 85-+.
2. Renner, R., Reaction to the Solution: Lead Exposure Following Partial Service Line Replacement. *Environmental health perspectives* **2010,** *118*, (5).
3. Cartier, C.; Arnold Jr, R. B.; Triantafyllidou, S.; Prévost, M.; Edwards, M., Effect of Flow Rate and Lead/Copper Pipe Sequence on Lead Release from Service Lines. *Water Research* **2012,** *46*, (13), 4142-4152.